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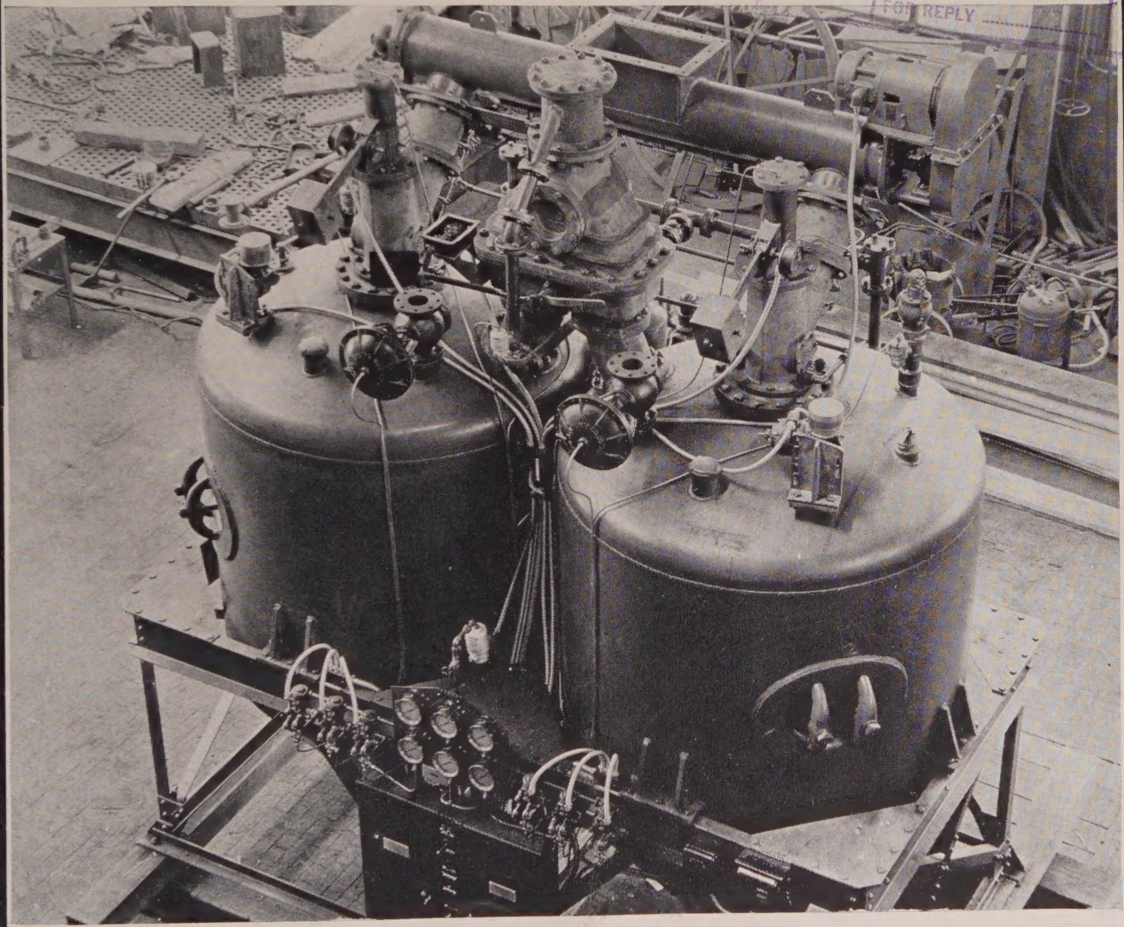

Automatic and flexible, low power consumption, minimum attention ● No operating parts in direct contact with the moving material ● Economically transports cement, pulverized dry cement raw mix, dry clay, gypsum, hydrated lime, phosphates, soda ash, etc.—from grinding mills to storage—dust collected at packing machines to silos—loading and unloading silos, storage bins, blending bins, etc. ● Cheapens silo construction by elimination of tunnels and deck slab.

●

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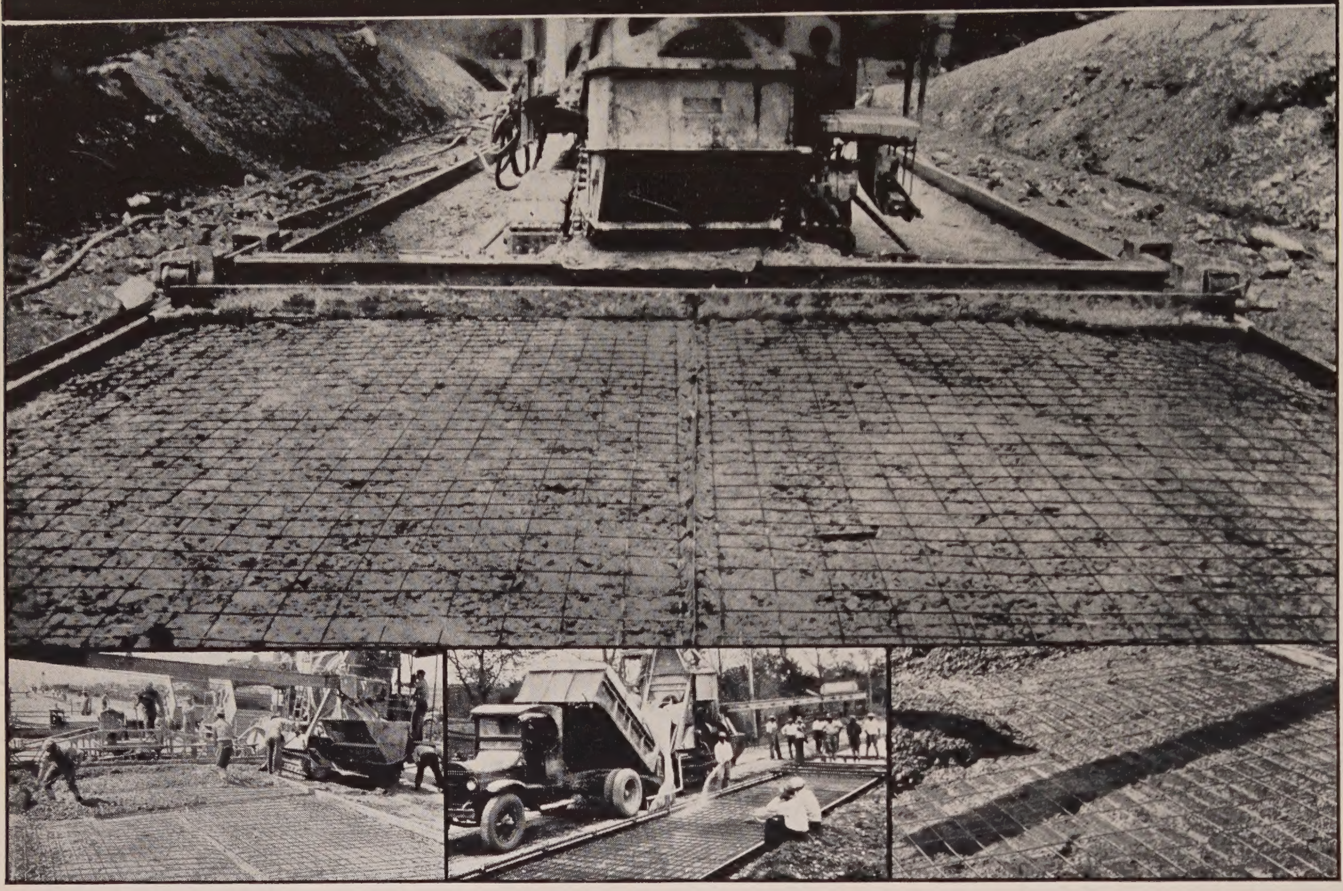

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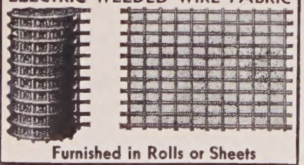

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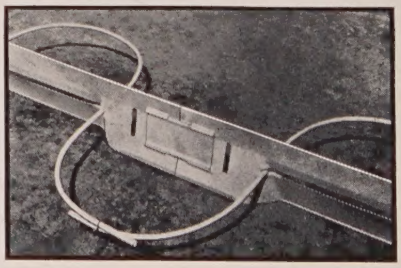

This new longitudinal joint for concrete roads serves the purpose of separating the pavement in definite slabs or lanes, which, at the same time, are interlocked and laced together. We are national distributors for the Smith Metal Laced Joint and shall be glad to send you a descriptive bulletin upon request.

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Vol. XLIII, No. 1 Concrete January, 1935

See Increased Concrete Paving Work in 1935

Repeal of Diversion Laws Expected as Result of Cartwright Bill—Tests and Investigations Bring Further Improvement in Paving Practice

THE chart here illustrated shows that in the first 11 months of 1934 the total of contracts awarded for the construction of concrete roads, streets and alleys stood at 38,806,864 sq. yd. This is slightly under the 39,210,000 sq. yd. awarded in the corresponding period of 1933; and it is probable that the final figures for 1934 will disclose a yardage of about 43,000,000, slightly below the previous year. On the point of actual construction of concrete pavements, however, the year 1934 outstripped 1933. It will be recalled that many of the contracts awarded in the later months of 1933—the PWA awards that created the upward bulge at that time—did not advance to the stage of actual construction until the spring and summer of 1934.

Cartwright Bill to Create Improvement

It has seemed each year that the delayed highway and street construction programs must have built up an enormous volume of potential construction that was only waiting to be released. But each year our state highway departments found their hands tied with increasingly strong cords, because the highway funds were being diverted to other uses, and the money that remained available had to be spent on maintenance.

Now the Cartwright bill, passed by the last Congress, provides a very definite cause for rejoicing. To begin with, this bill established a highway construction program of 3 years' duration, and it appropriates $532,000,000 as the federal government's part in that program. This sum is made up of an appropriation of $100,000,000 in the form of direct grants to states; $72,000,000 for roads in national parks and on public lands; and $350,000,000 to be matched by equal appropriations from the various states, on the old federal-aid basis.

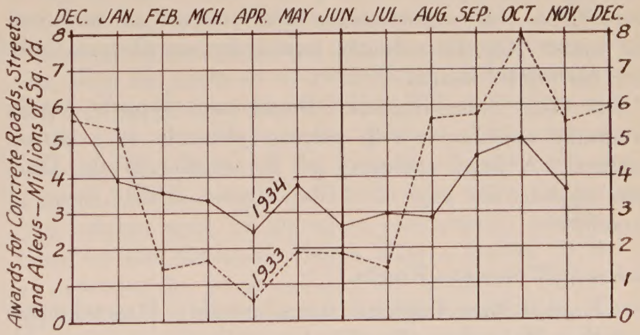
No Federal Aid Where Diversion Continues

This last-named item of $350,000,000 is the one that contains genuine encouragement to the highway construction industry, for after July 1, 1935, no state that is then diverting its gasoline and automobile license funds to uses other than highway construction and maintenance will be allowed to participate in that appropriation. More than 40 state legislatures will be in session shortly after January 1, 1935. It is expected that in all these states where highway funds are now being diverted, the state highway departments and various organizations interested in highway construction will do everything possible toward having diversion laws repealed. Their slogan might well be "No repeal, no federal aid."

Because of the circumstance just described, it is expected that many states will repeal their present diversion laws and replace them with the general sales tax.

Vibration Improves Pavement Concrete

In spite of the relatively low volume of contracts for concrete pavements in 1934, the year saw paving progress in many directions. For example, some notable additions were made to main traffic arteries in metropolitan areas. Large and small airports placed additional concrete runways and aprons. And in the field of experimentation, a 2-mile strip of highway in Illinois[1] provided further proof of the value of separating coarse aggregates into two or more sizes. In the matter of high-frequency vibration in the placing of pavement concrete, the Ohio State Highway Department, in the latter part of the year, conducted rather extensive tests of the use of a platform vibrator in placing cement-bound macadam.[2] Tests conducted by the same state disclosed the improvement to pavement concrete obtained through high-frequency vibration.[3]



Concrete pavement construction contracts, expressed in sq. yd., in 1933 and 1934—

First 11 months of 1933	39,210,000 sq. yd.
First 11 months of 1934	38,806,864 sq. yd.

Need of Water-Tight Expansion Joints

Extensive studies of the cause and prevention of warping of concrete slabs have been conducted by the Portland Cement Association, and by state highway departments of Kansas and other states. The cause and the prevention are both rather clearly established, the cause being the entry of water through joints and the consequent swelling of the subgrade, and heaving during freezing weather. The prevention, of course, involves the construction of water-tight joints, and proper preparation and drainage of the subgrade.

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[1] See July (1934) issue of CONCRETE, page 4.

[2] See also November (1934) issue of CONCRETE, page 14.

[3] See June (1934) issue of CONCRETE, page 10.

Joints in concrete roads and streets form the subject of a series of two articles beginning in this issue of CONCRETE.

An extensive study of expansion joint materials, made by the Indiana State Highway Department, is reported on page 22 of the June (1934) issue of CONCRETE.

Concrete Paving in Winter

Much attention has been devoted within the past year to the development of construction procedure in placing concrete pavement work in cold weather. This is made the subject of a special article in this issue; and in addition, interested readers are referred to articles in the January (1934) issue of CONCRETE, page 7; in the April issue, page 18; in the May issue, page 3; and in the June issue, pages 6 and 7.

Obviously, high-early-strength cement plays an important part in cold-weather paving work, and the same is true of the integral use of calcium chloride. Both of these products are discussed in the special article on cold-weather concrete paving appearing elsewhere in this issue.

Curing Methods

The various methods of curing concrete pavements—by the application of calcium chloride, sodium silicate, bituminous coatings, paper, burlap, straw, wet earth, etc., have a new competitor in the form of loosely woven cotton mats. For several years the U. S. Bureau of Public Roads, working in co-operation with the Texas State Highway Department, has experimented with the use of such cotton mats. Reports recently issued by the Bureau indicate favorable results.

The Ohio State Highway Department reports highly favorable experience with calcium chloride as a curing medium. A brief summary of the results of the Ohio tests appears on page 4 of the August (1934) issue of CONCRETE.

Color in Concrete Roads

Several New England states, notably Massachusetts and New Hampshire, have had encouraging success with the use of carbon black in obtaining dark colored concrete in alternate lanes of pavement. The contrast in the color of these alternate lanes has proved a most effective aid to motorists, especially at night, and traffic accidents are greatly reduced.

Maintenance costs and practices have received considerable attention during the year. The Highway Research Board, Washington, D. C., is making a special study of this subject,[4] and the Portland Cement Association has offered a recommended practice, or procedure, for repairing concrete pavements.[5]

Single-lane concrete roads for secondary highways have long since proved their case. Cement-bound macadam has made further gains during 1934, not only for secondary roads, but for the widening of principal roads, for street pavements, and for industrial driveways. A notable feature of the progress in cement-bound macadam is its frequent selection for projects under the jurisdiction of the CCC and the CWA, where semi-skilled labor must of necessity be employed.

More Paving in 1935

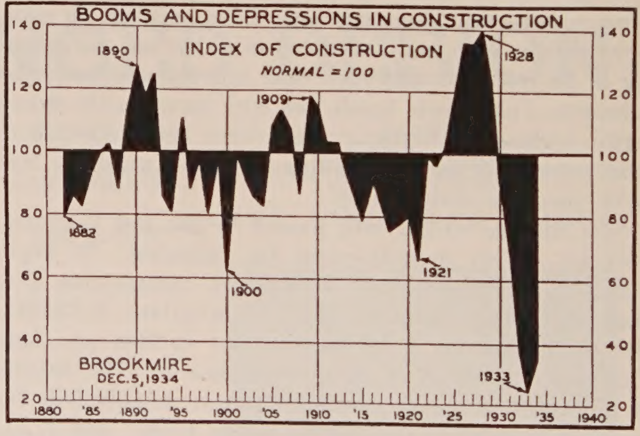
In view of the favorable situation created by the Cartwright bill, previously mentioned, there seems to be little doubt that 1935 will see a substantial increase in concrete paving contracts. One thing that is urgently needed, of course, is the complete co-ordination of effort on the part of the friends of good roads. Through such co-ordination, state legislatures can be induced to return at least a part of the diverted stream of highway construction funds to its original use.

Construction Revival Predicted

(From Brookmire Review—December 5, 1934)

BUILDING revival is on the way. Activity in this industry fluctuates in great cycles. The pendulum has swung too far on the down side in recent years and is beginning to swing in the upward direction.

The annual building trend since 1882 is illustrated on the chart. Comparison of the present low point of the cycle with earlier periods suggests the amount of improvement which lies ahead.



The subnormal rate of construction since 1929 represented by the black area below the 100 line was necessary at first in order to permit absorption of the surplus structures erected late in the previous boom represented by the area above the 100 line.

Continuation of the subnormal rate creates a shortage, though this has been potential rather than actual as long as families were compelled by financial necessity to double up. Increasing incomes are again permitting these families to seek separate quarters. The extent of this movement is reflected in the rise in rents.

Next spring will furnish a test of the building industry's capacity for recovery. The demand factor is becoming favorable, and great efforts will be made to facilitate the financing of new construction.

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[4] Reported in August (1934) issue of CONCRETE, page 18.

[5] August (1934) issue of CONCRETE, page 19, contains recommendations in full.

Improving Concrete for Public Work in St. Louis

Change Haphazard Methods to Well-Organized System of Control, Selection of Materials, and Inspection — Central-Mixing Plants Co-operate

By CHARLES W. BARNES, JR.
Civil Engineer in Charge of Concrete, Division of Sewers and Paving,
Board of Public Service, City of St. Louis, St. Louis, Mo.

Here is an encouraging story of the transition from haphazard methods of making concrete to the modern scientific methods of quality control. The training of men, the analysis and grading of materials, the modernizing of concrete-making equipment, and the improved methods of curing—all these are reflected in the results obtained in the period from 1928 to 1933, during which the average strength was nearly doubled.

The author, in his letter offering this manuscript, graciously gives credit to the magazine "Concrete" for a part of the inspiration that guided him in this development.—Editor.

IN 1927, Mr. W. W. Horner, chief engineer of the division of sewers and paving, city of St. Louis, wanting a better quality concrete in the pavements and sewers being constructed, formed a concrete subdepartment to make a study of the question and take the steps necessary to improve conditions. Previous to this time concrete had been generally produced in a rather haphazard manner, inaccurate measurement of aggregates, some cement and plenty of water having been the rule.

Haphazard Methods Needed Revision

The writer was placed in charge during 1928 and found that, although much improvement had been made in the previous year, much was left to be done. All projects were built under contract, and concrete was produced by mixers on the jobs, except for one central-mix plant. Commercial wet-hauling of concrete was in its infancy. Scientific production and control of concrete was comparatively new to the department's engineers.

In regard to materials, trouble occurred with some brands of cement which had a marked tendency to produce "bleeding" concrete, which was generally unsatisfactory. It was utterly impossible to use this kind of cement in wet-haul concrete with non-agitator trucks, because most of the water rose to the top, leaving the mass of concrete very dry. For fine aggregate almost any gradation of sand was accepted, the sources being from the Mississippi and Meramec rivers. For coarse aggregate, Meramec river gravel was specified for all finished concrete pavements and sewer inverts, and a large maximum size aggregate, either gravel or limestone, for pavement base concrete and sewer arches. Any available quality of limestone was used although the specifications were written to exclude the very inferior grades of rock.

Examples of Slipshod Practice

Six sacks per cubic yard of concrete was the cement content for sewers and finished concrete pavements, and four sacks per cubic yard for pavement bases for asphalt and block pavements. On account of the great variations in grading between shipments of aggregate, continual sieve tests were run at the central-mix plant's laboratory—the only field laboratory in the city. Then by means of the fineness modulus method the proportion of fine to coarse aggregates were determined and the mix was adjusted from time to time. Moisture tests on the aggregate were made daily and the water-cement ratio was determined. Unfortunately, in running these tests, the inspectors would at times barely surface-dry the aggregates and at other times would heat them for hours, thus entirely driving off the absorbed moisture, making the tests valueless. At the jobs where the mixers were located on the work the mixer tanks were calibrated and set at the season's start, and the proportions of sand to gravel rarely if ever were changed, and the concrete in general took care of itself. The contractor was sure to see that enough water was used.

In the measurements of quantities, fine aggregates were weighed and coarse aggregates were either weighed or measured by volume. The use of ordinary beam scales was often the cause of overweighing. At the central plant the mixing process was excellent. However, the mixers on the jobs were very poorly operated. The mixer operators were the judges of the amount of water used, and it was the exception rather than the rule when the consecutive batches were of the same consistency. Locking devices on the discharge chutes always seemed to be out of order, so the 30-second mix was common. Chutes were allowed on paving work for distributing concrete. Curing was very incomplete—generally a few pounds of calcium chloride were scattered over a large area of concrete pavement which had been deposited the previous day. There was no curing of sewer concrete.

Training Men and Grading Materials

In the succeeding years great progress was made in remedying the aforementioned conditions. An educational campaign was started among the material producers and contractors, in which the officials of the central-mix plant gave excellent co-operation. Certain picked inspectors were given special training in concrete. Specifications were modernized and enforced. Cement was improved in quality; the remedying of the "bleeding" allowed wet hauling. All sand shipments were checked by screen tests before acceptance. One grade of coarse aggregate was eventually substituted for the two different sizes formerly used, the grading being 2 in. to ¼-in., with certain percentage limits on intermediate screens. This grading was standardized for the whole St. Louis district. For thin sewer sections and sidewalks a smaller grade of coarse aggregate with a maximum size of 1 in. was used. A ledge-by-ledge geological survey was made of all quarries, and under strictly enforced specifications as to quality, crushed stone was considered as acceptable as gravel in all concrete except sewer inverts. The screening facilities of all gravel companies and quarries were modernized so that their products could meet the specifications.

Quality Control and Curing

The same cement contents were used in the mixes as before. The continual sieve tests for proportions of fine to coarse aggregates were virtually eliminated as the gradings became much more uniform. Care was taken in designing mixes to obtain durability as well as strength. Moisture tests were accurately made, and as much care in all particulars was taken in "dry-batch" work as at wet-mix plants. Cylinders and beams were tested frequently in order to get as complete control as possible.

In measuring quantities of materials, dial scales (preferably full dial springless) were required for all aggregates. Contractors were required to pile cement with one end of each sack visible, so accurate counts could be made at any time, thus giving the inspectors a chance to check against the load tickets. On the mixers the old water tanks were gradually eliminated and modern ones with automatic control substituted. These tanks were calibrated regularly. Locking devices were required to be in working order. Chutes for distributing concrete for paving work were eliminated. Curing was modernized; wet burlap was required as soon as it could be placed without marring the surface. After three days the contractor, if he elected, could remove the wet burlap and treat with calcium chloride or asphaltic spray, or he could leave the wet burlap on for an additional time. Wet burlap for 48 hours only was required on sewer arches.

Each Year Brings Improvement

In 1928 the department started core drilling operations to determine the thicknesses and quality of concrete pavements. The thicknesses are another story, but the average strengths of those cores broken are given in the accompanying table. The table does not show it, but each year brought an improvement in distribution of individual strengths; and the strengths became more consistent.

EACH YEAR BRINGS IMPROVEMENT IN CONCRETE IN ST. LOUIS

Year	Number of Breaks Obtained	Average 28-Day Strength of Concrete Cores, 6 Sacks per Cu. Yd.	Number of Breaks Obtained	Average 28-Day Strength of Concrete Cores, 4 Sacks per. Cu. Yd.
1928	58	2990	—	——
1929	48	3185	—	——
1930	156	4046	71	2661
1931	269	4329	55	3166
1932	62	4725	45	3182
1933	38	5236	36	3580

A. R. B. A. Convention and Exhibit to Push Highway Planning

THE American Road Builders' Convention and Highway Exhibit to be held at the Willard Hotel in Washington on January 22 to 25 will be of the greatest possible importance to every individual or organization connected with or related to the highway construction industry.

For National Highway Planning

The convention will formulate plans for a campaign to continue an adequate and economic highway program. The highway exhibit will present for the inspection of visitors the newest and most up-to-the-minute developments in road building and maintenance equipment and materials.

There will be a symposium on the gasoline tax diversion presented by the outstanding authorities of the country. This symposium will be based upon a study of conditions in every state in the Union. The conclusions and recommendations of this session will be of great importance to the states in conserving highway revenues for the highway program.

Problems that are of utmost importance to the highway contractor today will form the program of the Highway Contractors' Division. The theme of the convention will be:

(1) The continuation of an adequate and economic highway program.
(2) The conservation of highway revenues for highway purposes only—no diversion.
(3) The continuation of Federal appropriations for highway construction.

Outline of Convention Sessions

Following is a tentative outline of the convention program as given in the preliminary program:

Tuesday, January 22

2:00 P. M.—Opening Session
(1) Review of Highway Program
(2) Federal Legislation
(3) Continuation of Highway Program

Wednesday, January 23

10:00 A. M.—Manufacturers' Division Session
Highway Contractors' Session
City Officials' Session
County Highway Officials' Session
2:00 P. M.—Highway Contractors' Session
General Technical Session
4:00 P. M.—Pan-American Session

Thursday, January 24

2:00 P. M.—General Open Session
(1) Highway Progress
(2) A Planned National Highway Program
(3) New Legislation for the Continuance of the Highway Program

Concrete Pavement and Base Design Follows Known Principles

Details of Construction Practice for Street Pavements in District of Columbia—Expansion and Contraction Joints Provided—Permanent Traffic Markers Most Economical

By **H. F. CLEMMER**
Engineer of Materials, Department of Highways, District of Columbia, Washington, D. C.

IN the development of design principles for concrete pavements during the past decade, the many large programs of research carried on by federal and state departments have dealt, particularly, with conditions pertaining to state and rural pavements. These same principles should be followed in the design of municipal streets, proper consideration being given to the difference in subgrade conditions and the nature of the traffic. Many factors such as grades and the width of streets make design and construction of municipal pavements a more difficult problem.

Concrete Pavement Details

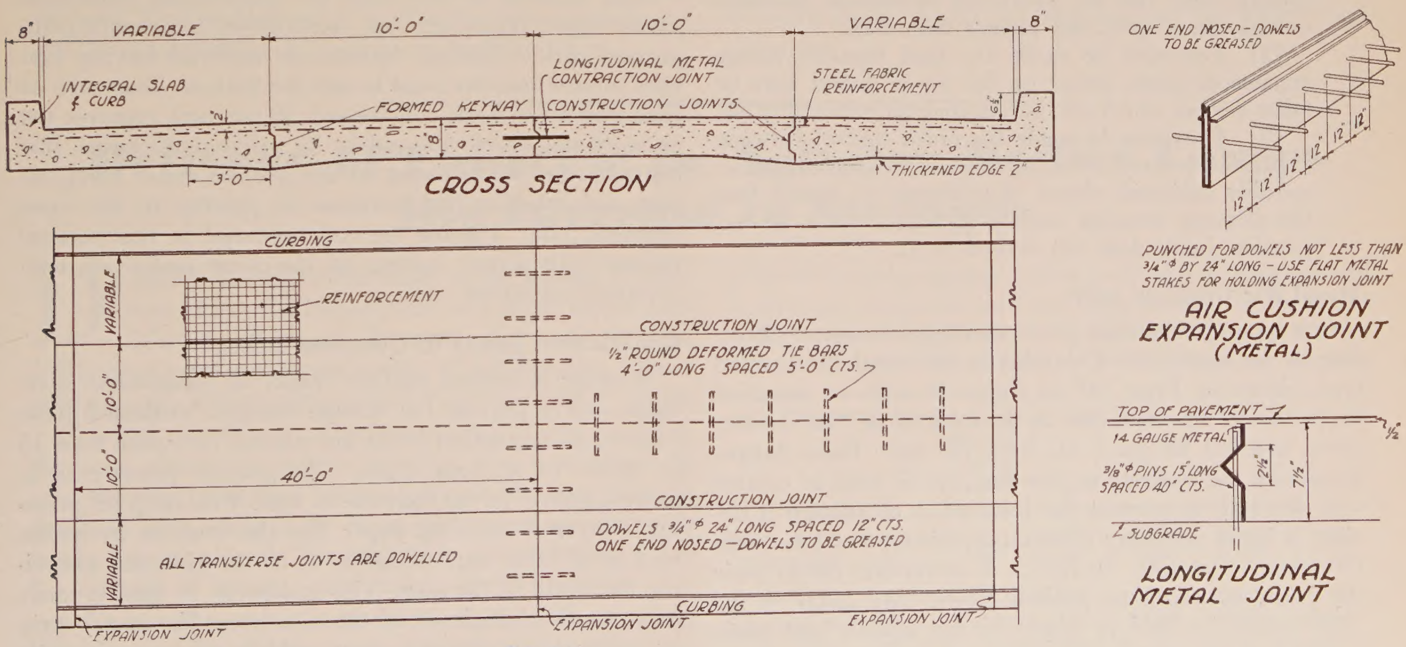
The Highway Department of the District of Columbia constructs a center 20-ft. section (Figure 1) following the thickened edge, center longitudinal contraction joint and mesh reinforcing principles, a design which is standard for many highway departments. This center slab provides for two 10-ft. traffic lanes. The essential variance of the Washington design from the so-called standard is the additional variable width side slabs (10 ft. maximum), and the curb and gutter sections, which, however, are used in the construction of many rural pavement systems. The side slabs provide additional traffic lanes, or they may be used for parking purposes. Formed keyways are constructed between the center 20-ft. slab and the side slabs by clamping metal or wood "V" shapes to the sides of the road forms. Deformed tie bars ½ in. round, 4 ft. long and spaced at 5-ft. intervals, are placed across the center longitudinal contraction joint.

Due to the very non-uniform subgrade conditions encountered in the District of Columbia it is not logical to specify a slab of standard thickness. The thickness of the concrete and the amount of reinforcing are varied in accordance with the subgrade stability and the type of traffic to be carried.

An important problem being given consideration at the present time in the design and construction of concrete pavements is that of providing for proper volume changes of the slab.

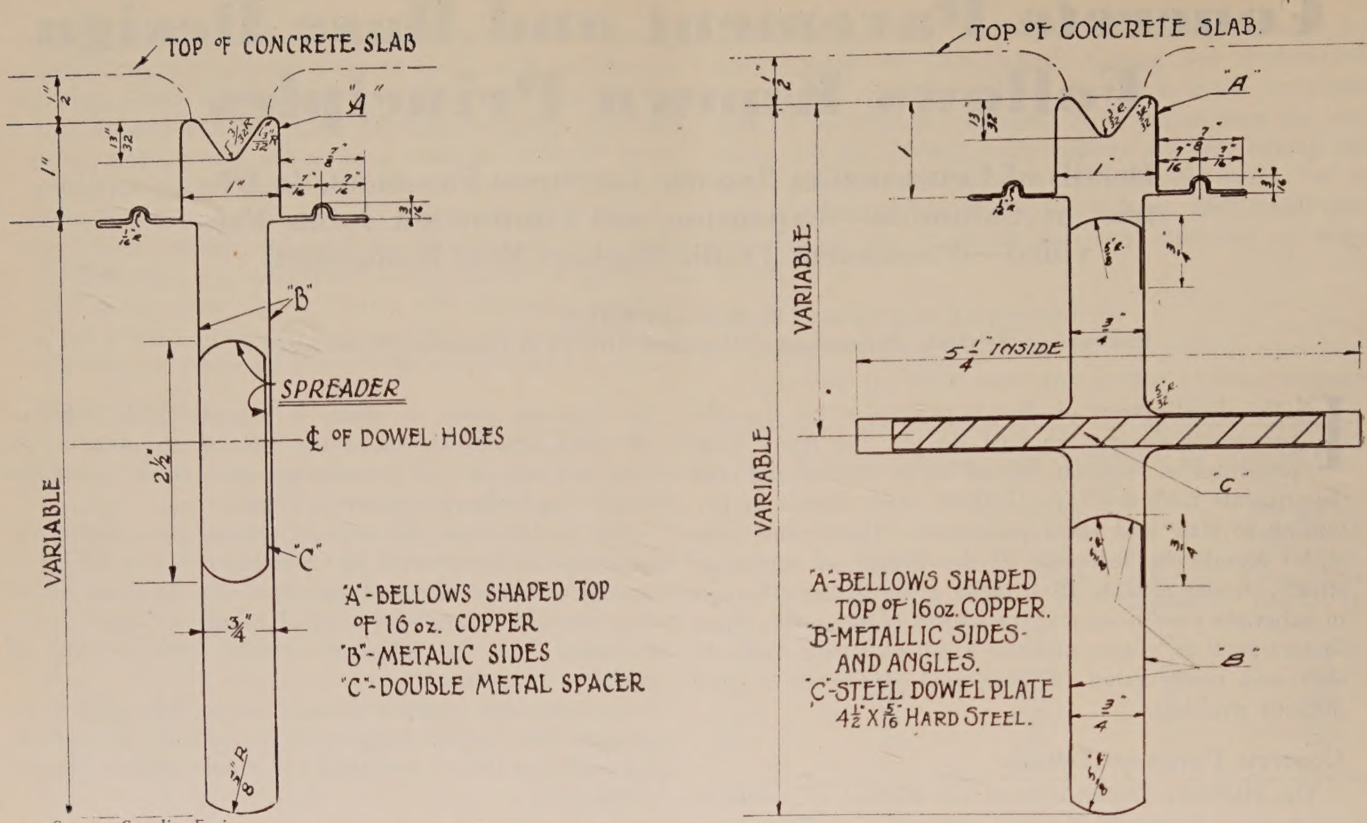
Absence of Joints Causes Fatigue

Some engineers have considered it more economical to repair blow-ups that may occur due to expansion during high temperatures than to provide properly for expansion of the concrete. However, consideration was not given to the fatigue effect resulting from repeated stresses set up by these expansive forces. When concrete is confined, variations in temperature and moisture cause stresses which are as effective in causing fatigue of the concrete as repeated super loads. Tests made to determine the effect of repeated loading of pavement concrete show it to have an


8"
VARIABLE
10'-0"
10'-0"
VARIABLE
8"
INTEGRAL SLAB & CURB
FORMED KEYWAY
LONGITUDINAL METAL CONTRACTION JOINT
CONSTRUCTION JOINTS
STEEL FABRIC REINFORCEMENT
6½"
THICKENED EDGE 2"
3'-0"
CROSS SECTION
CURBING
REINFORCEMENT
VARIABLE
10'-0"
10'-0"
VARIABLE
CONSTRUCTION JOINT
½" ROUND DEFORMED TIE BARS 4'-0" LONG SPACED 5'-0" CTS.
40'-0"
CONSTRUCTION JOINT
DOWELS ¾"ϕ 24" LONG SPACED 12" CTS. ONE END NOSED—DOWELS TO BE GREASED
ALL TRANSVERSE JOINTS ARE DOWELLED
CURBING
EXPANSION JOINT
EXPANSION JOINT
EXPANSION JOINT
PLAN
ONE END NOSED - DOWELS TO BE GREASED
12"
12"
12"
12"
12"
12"
PUNCHED FOR DOWELS NOT LESS THAN ¾"ϕ BY 24" LONG - USE FLAT METAL STAKES FOR HOLDING EXPANSION JOINT
AIR CUSHION EXPANSION JOINT (METAL)
TOP OF PAVEMENT
½"
14 GAUGE METAL
⅜"ϕ PINS 15" LONG SPACED 40" CTS.
2½"
7½"
SUBGRADE
LONGITUDINAL METAL JOINT

Courtesy Canadian Engineer

Figure 1. Standard concrete street pavement section, District of Columbia. The central strip, 20 ft. wide, is similar to many state highway sections



Courtesy Canadian Engineer

Figure 2. Metal air cushion expansion joint. Type A, on left, is frequently installed. Type B (right) is now being considered. The upper part of the joint is left open, the corners being rounded

"elastic limit," or "endurance limit," of about 50 per cent.[1] Therefore, pavements should be designed so as to permit as full movement of the concrete as possible.

The U. S. Bureau of Public Roads, which is in charge of the expenditure of hundreds of millions of dollars for roads, has recently issued a memorandum requiring that—

> (1) Expansion joints be used at intervals not greater than 100 ft., providing expansion openings not less than ¾ in. nor greater than 1 in.
>
> (2) Provision be made for load transfer across expansion joints, either by the use of dowel bars or other devices which will accomplish the same purpose.
>
> (3) Provision be made for crack control between expansion joints by the use of steel reinforcement, or suitably designed planes of weakness so spaced that the distance between such contraction joints or expansion joints does not exceed 30 ft.

Metal Air Cushion Joint

One type of expansion joint used in pavement construction in the District of Columbia is the metal air cushion type, shown as Type "A" in Figure 2, with an annealed copper seal 1 in. wide, bent in the form of an "M," having ⅞-in. grooved flanges 1 in. from the top. These flanges bond with the concrete so that the joint is held in contact with the slab to prevent the infiltration of foreign material. It is not necessary to maintain this type of joint with bituminous material. In fact it is preferable not to pour the joint, inasmuch as pebbles which may lodge in the joint would be held in place by the asphalt and cause spalling of the edges of the slabs when expansion of the concrete takes place. The open joint also eliminates the unsightliness of extruding filler. Dowel bars, ¾ in. round, 24 in. long and spaced on 12-in. centers, are generally employed for transferring loads from one slab to another. The use of the continuous-dowel type of expansion joint, as illustrated in Figure 2, Type "B," is however, being considered. It is believed this type of joint insures more positive transfer of load.

Cork material is also used for maintaining expansion joints. Open type joints are constructed, into which compressed cork is placed, bituminous material having first been poured into the joint to seal the bottom. Inasmuch as cork which has been compressed 50 per cent requires ten or more minutes to expand to its original thickness, this material can be delivered to the project under compression and released just previous to placing in the open concrete joint. Placing the cork material in this manner insures satisfactory sealing of the joint under all temperature conditions.

Contraction Joints in Concrete Bases

In order to control surface cracks on bituminous pavements and to provide for volume changes, weakened-plane transverse contraction joints are placed, not more than 15 ft. apart, in all base slabs. The general practice is to make a groove in the concrete at least 4 in. deep by pressing a layer of building paper into the concrete by means of a metal strip approximately 3/16 in. wide and extending the width of the slab. This groove is, of course, made prior to the initial set of the concrete. The metal strip is removed immediately after making the groove, while the layer of building paper is allowed to remain in the base slab. Although the concrete is still in a plastic state after removal of the metal strip, the layer of paper prevents the adjacent sides of the groove from bonding, and during the setting of the concrete it provides for the formation of a crack through the remainder of the depth of the slab.

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[1] H. F. Clemmer, A. S. T. M. Vol. 22.

The above practice is modified to some extent to allow for subsequent expansion when construction is carried on at temperatures below 50 deg. F. In such instances expansion joints, in addition to the weakened planes, are placed at the tangent points of intersecting streets and at maximum interval of 300 ft.; that is, should the distance between tangent points be more than 300 ft., expansion joints would be placed at the mid-point as well as at the tangent points of the intersecting street.

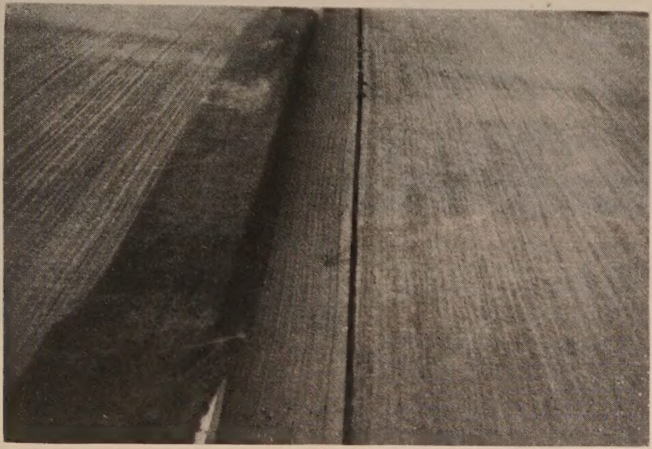


Figure 3. The surface is broomed after the concrete has been belted and straight-edged, but prior to the initial set

Due to the close spacing of these planes of weakness the movement of the individual sections is so small that cracks are not transmitted through the bituminous surface.

Some Minor Construction Details

Other practices of minor importance, but of interest as to design and construction, are the brooming of concrete surfaces, the installations of reinforcing around manholes, and the construction of permanent traffic markers.

In finishing the concrete surface of pavements a street broom approximately 1 ft. wide is pulled gently over the entire surface, perpendicular to the center line of the pavement, after the concrete has been belted and straight-edged, but prior to the initial set. The depth of the broom corrugations do not exceed ⅛ in. This method of finishing has been found to increase traction and improve the general appearance of the pavement, as may be noted in the illustration (Figure 3).

It is believed that radial cracks around manholes and similar fixtures, which are present in all city streets, are caused by localized stresses set up during the hardening of the concrete. Light-weight wire mesh (chicken wire) is placed about 2 in. below the surface of the concrete for a space of 2 yards square around the fixture. The use of this wire mesh distributes the stresses due to shrinkage during setting of the cement and eliminates cracking. Examination of more than 100 such installations, more than a year after construction, did not disclose a single crack. Elimination of these cracks often means elimination of ultimate pavement failures at such locations.

Permanent Traffic Markers Most Economical

Permanent traffic markers are constructed both for concrete and bituminous pavements. In general, concrete composed of white portland cement, white sand, and standard coarse aggregate is used, the aggregates and cement being mixed in the same proportions as for pavement concrete. Black colored concrete has been used with light colored concrete pavements, but it is believed the white marker is more visible when the pavement surface is wet. These markers are placed in the center of the pavement, and in some cases to divide the surface into 10-ft. traffic lanes. It has been found more economical to construct permanent traffic markers than to maintain painted traffic lanes.

From the foregoing discussion relating to design principles, it may be noted that the practices followed by the District of Columbia are in close agreement with the standard design principles employed by the larger highway units.

Delivery of Concrete in Agitator Bodies Causes Big Increase in Strength

DUDLEY T. CORNING, chief of the bureau of highways, City of Philadelphia, in a short report published in *Highway Research Abstracts*, October, 1934, gives some significant results of comparative tests of ready-mixed concrete delivered in different types of trucks.

Concrete mixed at a central mixing plant was hauled to the point where concrete paving work was in progress. In one case the trucks used were the open-body, non-agitating flat body type, while in the other case closed agitator body trucks were employed. The mixture in all cases was a 1-1.8-3.5 mixture of cement, sand and uncrushed gravel.

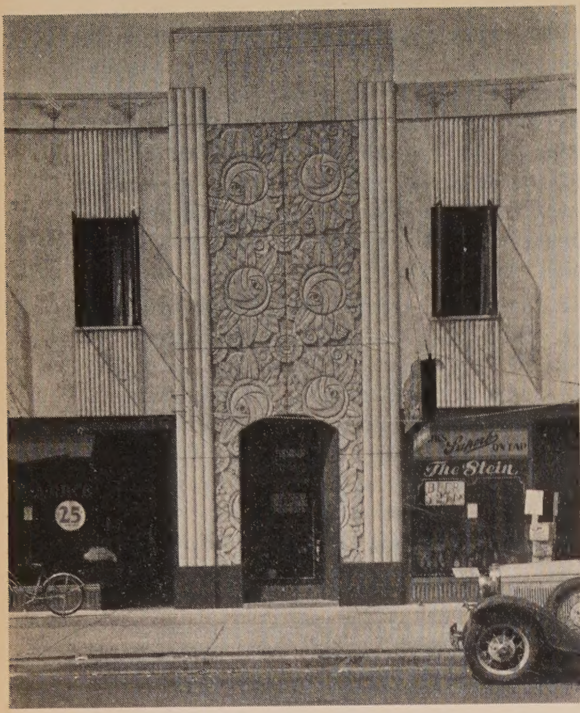
Cylinders at the plant were made as soon as the concrete was mixed. Job cylinders were taken after the concrete was discharged from the trucks. The significance of the test results is seen in the fact that the strength of the concrete was materially reduced as a result of delivery by flat open trucks, while delivery in agitator bodies resulted in a large increase in strength compared with the same concrete at the plant.

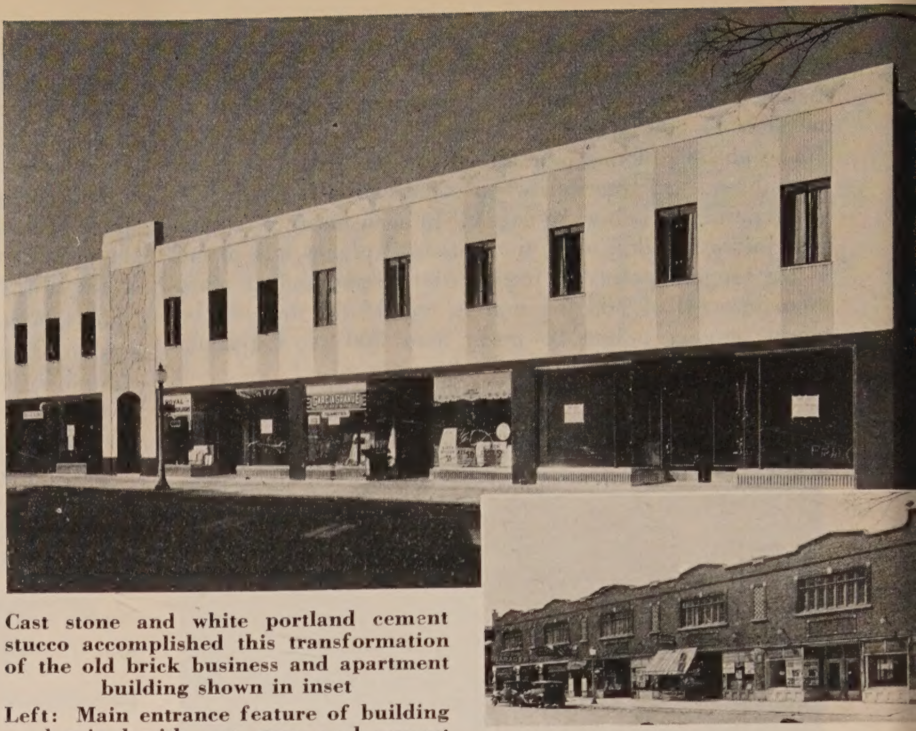
The lower strengths shown in the table opposite the agitator trucks are due entirely to the higher water content.

COMPRESSIVE STRENGTH OF CONCRETE, IN LB. PER SQ. IN.

Type of truck	Gallons of water per sack cement	7 days at plant	7 days on street	28 days at plant	28 days on street
Open, flat, non-agitating trucks	4.96	3,000 3,025	2,000 2.540	4,445 4,495	3,445 3,505
Agitating trucks	5.99	2,325 2,425	2.945 3,190	3,205 3,225	4,445 4,450

The agitator bodies used in these tests were the well known "conveyor conditioners" made by the Clinton Motors Corporation, Reading, Penna.





Cast stone and white portland cement stucco accomplished this transformation of the old brick business and apartment building shown in inset

Left: Main entrance feature of building modernized with cast stone and cement stucco

Cast Stone and Stucco
Modernize Old Brick Building

Tenants Are Undisturbed During Construction

THE leading article in the November issue of CONCRETE describes and illustrates the use of monolithic reinforced concrete in the modernization of an industrial plant.

Where Architects Play a Part

Similarly, the illustrations presented in this article show what another architect has accomplished in the modernization of a business and apartment building through the judicious use of cast stone and portland cement stucco. Both instances illustrate the types of building modernization in which architects and structural engineers may play a part.[1]

The building here illustrated is located in Morse Avenue, in the Rogers Park section of Chicago, and is owned by Jule Adler. The inset shows the building as it appeared before modernization—with a front wall of wire-cut brick and an architectural style typical of its period.

Prepared Stucco Applied to Old Brick

The modernized front was obtained by applying three coats of portland cement stucco directly on the brick, after the large window spaces of the old structure had been partly filled in with new brickwork of the same kind. The rough surface of this wire-cut brick formed an excellent bonding surface for the stucco. Prepared California stucco was employed in this work, and Atlas white cement was used in the final coat. In the application of the stucco the recommendations of the Portland Cement Association were carefully followed.

Fluting above and below the window openings, shown most clearly in the illustration of the principal entrance, was obtained by the use of this same prepared stucco, formed in molds of sheet metal, half at a time.

Generous Use of Cast Stone

Generous use was made of cast stone, more especially in the main entrance feature. This material comprises the black granite-like base course at the main entrance and the first-story pilasters between business rooms. Cast stone also was used for the main entrance feature, throughout its full height, and for the ornamental coping along the entire front.

Acknowledgments

This work was executed under the supervision of C. E. Miller, of the firm of B. Leo Steif and Co., Architects, of Chicago, designers of the modernized structure. The cast stone work was supplied by the Architectural Cast Stone Co. The masonry contractor was Paul H. Schwendener, while the stucco contractor was the Kjellberg Plastering Co.

Through careful scheduling of the work and protection to tenants, it was possible to complete the entire project without requiring tenants to vacate, or without causing them discomfort.

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[1] Readers are referred also to the article by Dr. E. Lee Heidenreich in the April (1934) issue of CONCRETE, headed "Rehabilitate Old Commercial Buildings with Reinforced Concrete," for further ideas on this subject.

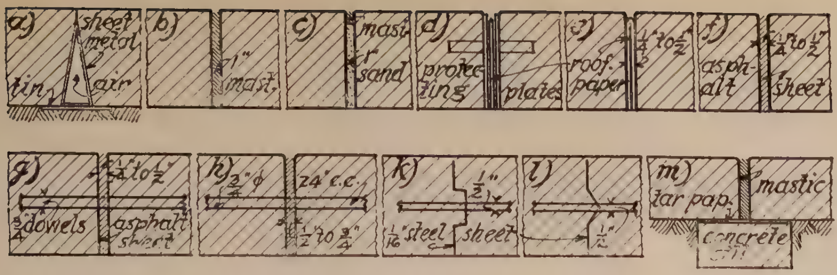


Figure 1. The upper left-hand joint, at (a), patented in 1885, contained some of the requirements of a good concrete highway joint. Others here illustrated show that little progress had been made up to 1925

Joints for Concrete Highways

Demand Use of Engineering Principles

Historical Review of Joint Design Since 1885—Forty Years of Groping Brought Little Progress

By L. J. MENSCH
Consulting Engineer, Chicago, Ill.

IN the spring of 1902 the writer read a paper before the Architects' Society of Cincinnati on the progress of reinforced concrete construction in Europe. On the next day he was shown an interesting specimen of concrete work, a pavement leading to a cemetery in that city. It looked like new, but the superintendent assured us that the pavement was 20 years old. Evidently many other concrete pavements were built around that time, because a contractor of Cincinnati obtained Letters Patent in 1885 on a joint, as shown in Figure 1-a, with the object "to permit the separate blocks of pavement to heave freely should the foundation or any part of it be raised by the action of frost or by settling of the foundation, and also to form a close joint on top, which gives the pavement a better appearance and also prevents the percolation of water through the joints." He obtained the opening between the slabs by using a thin sheet of metal bent into a V shape and left permanently in the joint. The Patent further said "that the base of this sheet metal ought to rest on a strip of tin or other suitable material, to prevent the ground from working up between the inclined sides. The metal of the joint should be just heavy enough to admit of the material being tamped down without crushing it, and yet light enough to crush together in case the blocks should heave."

We see that he enumerated most of the requirements of a good joint, but it took more than 40 years before his successors saw the light.

Some Early Joints

Concrete pavements were built at Bellefontaine, Ohio, in 1892, and at Richmond, Ind., in 1896, which had both longitudinal and transverse joints, as shown in Figure 1-b. The pavements were laid in blocks 8 by 8 to 10 by 15 ft., and in imitation of brick pavements the one-inch joints were filled with a bituminous mixture. Sometimes dry sand was filled in the space between the slabs and only the upper part filled with bitumen, a practice used even today in Texas, where the sand is replaced by cotton seed hulls or sawdust. The edges of the blocks were subjected to destructive action from the hoofs of horses and from steel tires, and later pavements had joints farther apart, and soon the longitudinal joints were entirely omitted. Narrower joints and steel protection plates, anchored to the ends of the slabs, were then advocated and the space between the plates filled with several layers of roofing paper, or asphalt impregnated felt.

On the Continent and in England, the early concrete pavements, from 8 to 12 in. thick, were built without joints; after the first winter transverse cracks showed up at distances from 50 to 100 ft., and thereafter transverse joints were used from 30 to 50 ft. apart, sometimes lined with protection plates for nearly the full depth of pavement. The space between the slabs or plates, generally about ½ in., was filled with a bituminous mixture. European practice has not changed much up to this day, except that in France wood strips have been used as separators and a cement colored plastic material is used in a small recess cut at the top so as not to disfigure the pavement.

Give Much Attention to Joints

In the *Proceedings* of the National Association of Cement Users and its successor, the American Concrete Institute, we find many references to joints in concrete pavements. The 1910 specifications for concrete roads require joints at least ½ in. wide and at distances not to exceed 50 ft. These specifications were altered in 1912 to a joint spacing of 25 ft. and a thickness of not less than ¼ in. and not more than ½ in. In 1914, A. N. Johnson, then head of the Illinois Highway Commission, was chairman of the committee on concrete roads of that association, and the requirements were changed to a joint spacing of 36 ft. and less. Most of the joints at that time were filled with layers of roofing paper and only a few pavements had joints with protection plates. The same committee required in 1916 the use of longitudinal joints in all pavements with street car tracks, and mentioned the use of pre-molded asphalt strips. In 1917, Leroy Ulrich, of the State Highway Department of Connecticut, mentioned in a paper read before the Institute that longitudinal cracks were of most frequent and annoying occurrence, that water entered cracks from the top and the sides of the road and softened the subgrade, and when this water froze in winter, it caused unequal heaving and many additional cracks.

Longitudinal joints in wide concrete pavements were mentioned again in the *Proceedings* of the Institute in 1917.

Bates Road Tests

The "Recommended Practice for Concrete Roads" in the 1918 *Proceedings* first mentioned contraction joints other than construction joints, advising a spacing of such contraction joints of 30 ft. and the insertion of a thin sheet of metal, 1/32 in. thick, extending within 1 in. or less of the surface. The committee also stated that there was a tendency toward increasing the spacing of expansion joints to 50 ft. The use of protection plates was discouraged. The 1923 specifications first mentioned the use of dowels across joints, advising to make them of ¾ in. round plain bars, 3 ft. long, and to cover one-half of the dowels with paper or to paint them with grease or oil and to use metal caps at the ends. Meanwhile the famous Bates experimental road tests had been made by the State of Illinois under the direction of Clifford Older, chief highway engineer; also elaborate tests had been made at the Pittsburg, Calif., experimental road. These very thorough tests clearly demonstrated that longitudinal joints greatly diminish longitudinal cracking, and that the use of dowels were of advantage at both longitudinal and transverse joints. Nothing was learned about how to proportion the dowels, but it was now clear that longitudinal joints of the "V" or tongue-and-groove type, as had been used for a generation previously in European and American bridge practice, and were also mentioned in the 1885 patent above referred to, would greatly facilitate the transmission of wheel loads from one side of the joint to the other, and thereby reduce the stresses in the slabs due to the ever increasing truck loadings.

Apply Engineering Design

Figures 1 (a) to 1 (m) illustrate the joints we have described, and some others. Thus we see that no great progress had been made in the development of joints in the first quarter of this century. Neither is it surprising, because concrete roads were considered low-priced pavements which ought to be built for $1.00 per sq. yd. and less—that is, $10,000 per mile, 18 ft. wide. When at the end of 1917 our railroad facilities proved insufficient for the movement of the enormous quantities of freight resulting from the feverish production of war materials, large-scale trucking for long distances, even for a thousand miles, first made its appearance. Nobody dared to stop a truck carrying the U. S. flag, even if wheel loads exceeded the legal limits. The existing roads were not built for such abuse, and showed unexpected deficiencies. Engineers realized that the time of guessing at road design had passed and that roads had to be designed on strictly engineering principles. It was a laudable notion, but was easier said than done. Little they knew then that the subject was more intricate than the design of a large suspension bridge, for example, and of much greater national importance. The many breaks at corners and joints and between joints demanded immediate strengthening of the design of future roads.

The idea of strengthening the slabs by the insertion of dowels across the joints appeared in that year. However unbelievable it may sound, an "inventor" in that year obtained Letters Patent on a joint with dowels. Dowels across joints had been used in reinforced concrete construction, especially at construction joints and in premolded concrete members, since the infancy of concrete construction. The actual joint as described in the patent was used by the writer in 1909 in Chicago. Of course, nobody paid any attention to that patent, and the use of dowels was slowly introduced in paving practice. The analysis of the design of dowels was too strange a subject for engineers to tackle, and guessing was again resorted to.

For transverse joints ¾-in. dowels were mostly used in lengths of 3 to 5 ft., and about the same distances apart. A so-called marginal bar, sometimes called shear or edge bar, which was greased for the entire length, was very much in vogue. When some field tests and also the Bates experimental road tests showed that the ¾-in. bar dowels became partly inactive after a time, the dowel spacing was reduced to 2 ft. and the length of 4 ft. became a standard. Nobody made tests to find out whether this spacing or the length was proper to carry the maximum wheel loads. For longitudinal joints the tongue and groove interlock was considered sufficient to transmit 50 per cent of the wheel loads and so-called tie bars, ½-in. corrugated rounds, 4 ft. long and 5 ft. centers, were not considered to function as shear transmitting elements, but only to hold the slabs together against movements due to temperature and moisture variation. Also here a change is taking place. The state of Illinois has altered its practice late in 1934 and requires now a ½-in. tie bar, 2 ft. long, 2 ft. on centers, evidently considering these bars to have to act as shear transmitting members also.

(A second installment of this article will show how highway engineers have now adopted some of the details found in bridge joints.)

Mineral Aggregates Conventions

THE annual conventions of the National Crushed Stone Association, the National Sand and Gravel Association and the National Slag Association will meet at the Palmer House, Chicago, Illinois, January 27 to February 1, inclusive. At the same time will be held the second annual meeting of the National Code Authority of the crushed stone, sand and gravel, and slag industries.

Of interest will be an industrial exhibit of the combined Manufacturers' Divisions of the National Crushed Stone Association and the National Sand and Gravel Association.

Housing Authorities Authorized

CITIES of California, Illinois, Indiana, Kentucky, Michigan, New Jersey, New York, Ohio, South Carolina, West Virginia, and Wisconsin have power to create municipal housing authorities. Such authorities are independent bodies, empowered to borrow funds for housing projects from the federal government, or to issue bonds for the same purpose, to acquire land through condemnation or purchase, to clear unhealthy and sub-standard areas, and to construct and supervise local housing projects.

◆ EDITORIAL ◆

See More Construction in 1935

Reference is made in the leading article in this issue to the improved prospects for highway construction because of the provisions of the Hayden-Cartwright Act passed by Congress last June. This measure, which makes provision for a three-year highway construction program under federal aid, also places a heavy penalty on states which continue the diversion of gasoline tax and automobile license fees after July 1, 1935.

Highway construction, however, is not the only direction in which the outlook for 1935 construction has taken a favorable turn. Under the dynamic leadership of James A. Moffett the Federal Housing Administration is getting quite unexpected results, in spite the cynical attitude at first assumed by many leading newspapers, bankers and industrialists.

The more slowly moving PWA, on its part, is preparing to continue on a broad scale of public works construction, by means of funds to be provided by the incoming Congress. To quote from the "Brookmire Analyst" of December 15, "The Government's emphasis on the revival of building and construction is very logical because it will greatly aid the depressed heavy industries and thus become an important factor in further sustained business recovery."

Most encouraging of all is the well-known fact that administrative officials and congressional leaders at Washington have at last come to a full realization that the construction industry holds a key position in the campaign for business recovery.

It is expected, therefore, that government construction will be tapered off only as private construction takes up the slack.

Road Builders Must Impress Washington

The American Road Builders' Association convention and exhibit to be held in Washington during the present month comes at an opportune time and place, when one considers the impression that may be made on the members of the incoming Congress.

Coming, as it does, within a few weeks after the convening of our national legislative body, it is to be hoped that this great convention and exhibit will impress the legislators with the vastness of the highway construction program, and its possibilities in furthering the recovery program.

It is gratifying and encouraging to know that during the past year many of the officials of the federal government, including leaders of Congress as well as officials of the administration, have seen the light. They have seen how highway construction created useful employment throughout the United States during the past year. They know that highway construction has merited the favorable attention which it has attracted in all sections of the country, and quite properly they attribute this popular favor to the almost universal use of our highways, to the speed with which highway construction gets under way, to its great opportunities for employment, its stimulation of the capital goods industries, and to the sound economic value of good roads.

It may be taken for granted that, both collectively and individually, delegates and visitors to the A. R. B. A. convention will utilize every opportunity to impress Congress and the administration with the need for expanding the highway construction program, and for pushing to the utmost the program already laid out. When additional federal funds are appropriated for public works, highway work should figure prominently in the allocation of those funds.

Unlimited Field for Construction

The Hayden-Cartwright Act passed by Congress last June has provided a commendable start in the national program of planned highway development. It insures a substantial amount of federal aid throughout the three-year period ending July 1, 1937.

The work coming under the Hayden-Cartwright Act, however, is limited to the improvement of our primary highway systems. Funds for secondary road work, grade-crossing elimination and relief of city traffic congestion will be exhausted with the expenditure of the emergency authorization of the current fiscal year.

Secretary Ickes has on various occasions mentioned an extensive program of grade-crossing elimination as one of the most worthy outlets for the expenditure of public works funds. If to this program we add secondary roads and the elimination of traffic congestion in metropolitan areas, we have an almost unlimited field for the construction of needed projects that will add immeasurably to the permanent wealth of the nation.

Tapering Off Public Spending

James A. Moffett, Federal Housing Administrator, has told of promises obtained from industrial leaders to spend large sums in 1935 for modernization of industrial plants and equipment. The total of definite promises thus far obtained amounts to nearly a billion dollars.

Not all of these promises will be translated into actual construction work, but many of them will. Construction of this type is exactly what is needed to taper off the necessity for public spending. We may see much of it in 1935.

PROGRESS — In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Load Distribution on Concrete Pavements

THE much-discussed question of load distribution on a concrete slab is the subject of a paper by R. D. Bradbury, director of the Wire Reinforcement Institute, read before the fourteenth annual meeting of the Highway Research Board in Washington early in December. The author declares that the specific objective of his study is a consistent evaluation of proper allowable wheel-load distribution factors for stress computations. Certain investigational data pertaining to tire-pavement contacts are reviewed and interpreted. Essential information and analysis of common types and arrangements of both single and dual pneumatic tire equipment are presented.

A special feature of the paper is an analytical evaluation of the distribution factor for dual-tire equipment by considering, for each critical load position, the individual stress effect of companion tires, and deriving therefrom an equivalent radius of distribution for the wheel load as a whole. This results in phases of wheel-load distribution not disclosed by the common method of deducing an equivalent radius.

Empirical formulas for computing load distribution radii for different load positions are developed, and a tabulation of numerical values of the radii is presented for several critical load positions and for wheel loads from 1,000 to 16,000 lb.

Avoiding Slippery Road Surfaces

IN a paper headed "Design of Concrete Surfaces to Obviate Slipperiness," presented before the fourteenth annual meeting of the Highway Research Board by E. M. Fleming, manager of the highways bureau of the Portland Cement Association, the author concludes that concrete surfaces have coefficients of friction high enough for safety under general driving conditions, due to certain inherent factors such as uniformly even surface, uniformity of texture, permanence of surface conditions, and low crown. More definite knowledge is desirable, especially concerning the safe values for the two coefficients—first, that of impending skid; and second, that of sliding friction. It should be determined which of these coefficients is the critical one. The difference between the two values may also be of consequence. The investigation of coefficient values should also include the production of various surface textures by different finishing methods.

The author states that theoretical consideration indicates that a limit may be imposed on speed by the coefficients of friction. What the limit is will be determined by the maximum practical coefficients that can be developed for road surfaces.

A. S. T. M. Tentative Standards

THE 1934 edition of the *Book of A. S. T. M. Tentative Standards*, containing all of the 236 A. S. T. M. tentative specifications and test methods, is now available.

Copies may be obtained from the American Society for Testing Materials, at $8.00 (cloth) and $7.00 (paper).

Research Work of A. S. T. M. Committees

NUMEROUS research activities are going forward under the direction of various committees of the American Society for Testing Materials. Notable among these studies and investigations are the following:

Volume Change and Soundness of Portland Cement (Committee C-1).—To obtain information on (1) volume change of neat cement bars when subject to various temperatures and storage conditions and (2) the influence of cement on volume change characteristics of neat cement, mortar and concrete, under various conditions of storage. Data reported on item one for 16 commercial cements, see preprint, 1934 Report of Committee C-1. Other studies described in paper by H. F. Gonnerman on "Study of Cement Composition in Relation to Strength, Volume Change, Resistance to Sulfate and to Freezing and Thawing of Mortars and Concrete," see 1934 reprint.

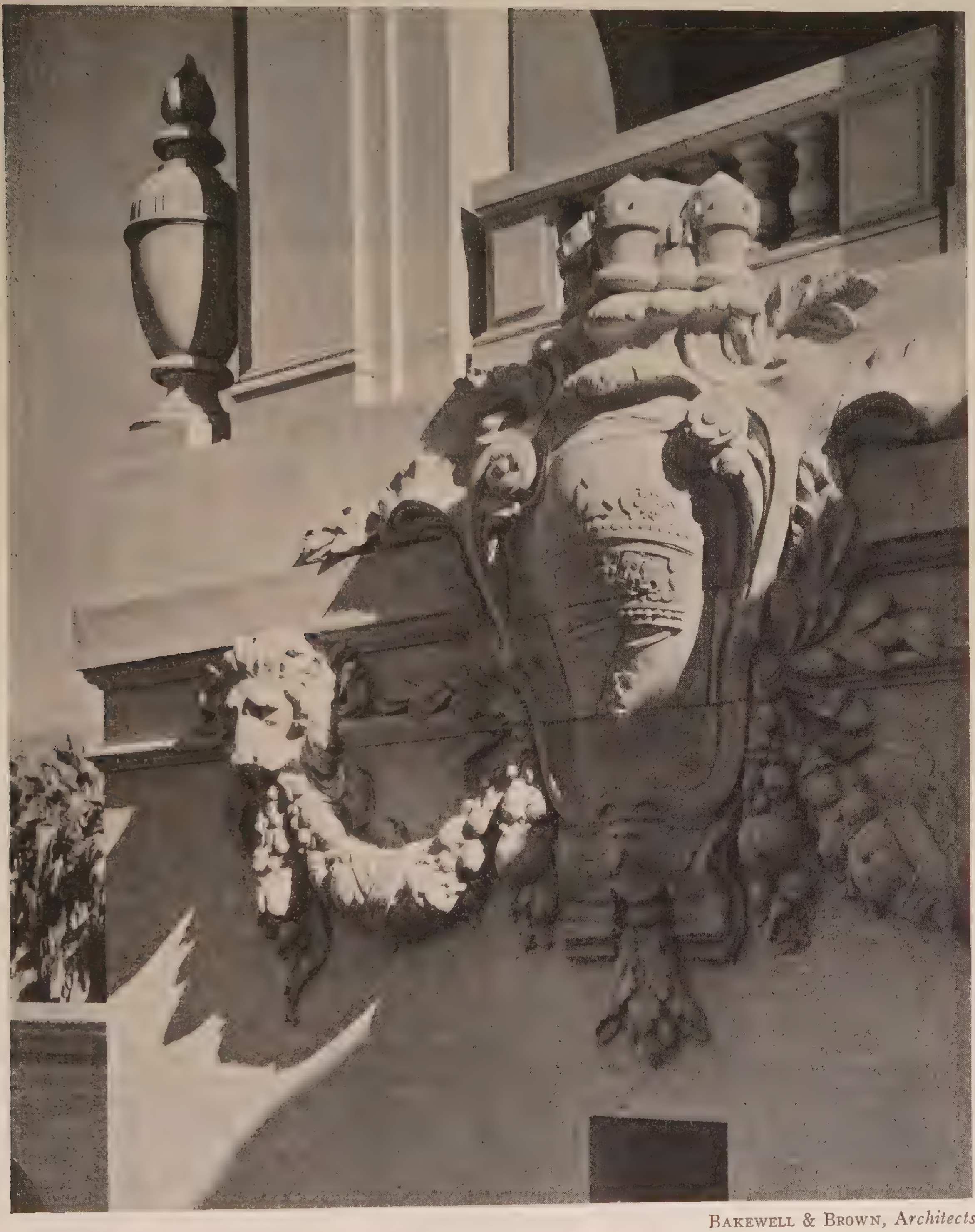
Research in Mineral Aggregates (Joint Committee).—Correlation of research in mineral aggregates under auspices of the Highway Research Board, National Research Council. Considerable information assembled on the nature of shale and its effect when present in aggregates used in concrete and on coatings of various sorts on aggregates and their effects. Abrasion, hardness and toughness tests are receiving attention, and the significance of flat or elongated particles in aggregates is being considered. The committee is in constant touch with researches throughout the country on accelerated durability tests for aggregates. The standardization of an accelerated test and correlation with service behavior is recognized as a pressing necessity, and the Committee is seeking to encourage co-ordination in these researches by distributing research outlines to interested agencies. See Report of Joint Committee, *Proceedings*, Highway Research Board, Vol. 12, Part I, p. 265 (1932).

Weathering Characteristics of Masonry Materials.—Study of the weathering characteristics of such masonry materials as brick, concrete, hollow masonry building units, slate and building stone.

NOTE.—The work of Committees C-3, C-9, C-10, C-18 and D-16, in the study of weathering characteristics and development of accelerated weathering tests is being co-ordinated through the Co-ordinating Committee on Weathering Characteristics. Symposium on Weathering Characteristics of Masonry Materials held in 1931, see *Proceedings*, Vol. 31, Part II, p. 715 (1931).

Studies of Designing and Proportioning of Concrete (Committee C-9).—Analyzing the existing data on various theories of preparing concrete mixtures and of developing a recommended procedure for the design or determination of a concrete mixture on the basis of strength and workability. Not yet reported upon.

Architectural Concrete



Bakewell & Brown, *Architects*

Architectural detail in City Hall, Pasadena, Calif. Made of precast concrete, set in place before the wall was stuccoed

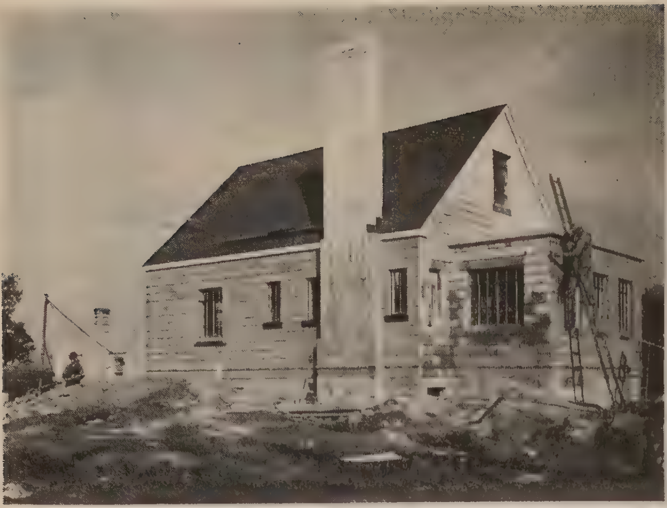
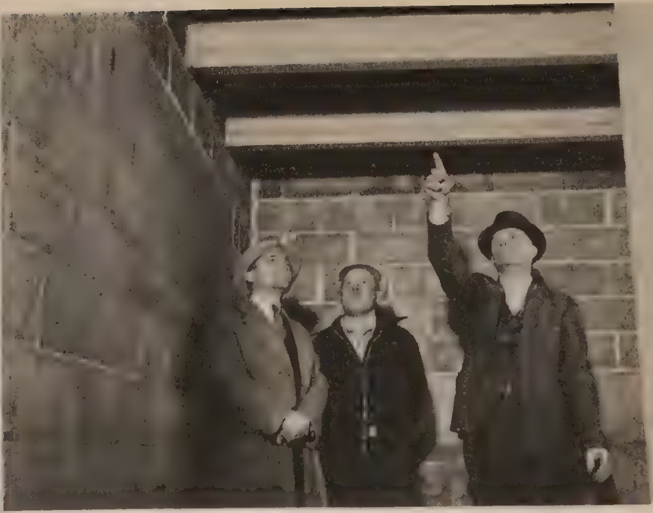



Figure 1 (Left). Unusual effect obtained with new type of concrete wall unit, coated with white cement paint. In this picture only the gable end had been painted. Figure 2 (Right). Fireproof character of floor construction may be seen from basement. Left to right: J. Fletcher Lankton, architect; Theodore Hulter, owner; and Emil Zuber, products manufacturer

New Concrete Masonry Wall Unit Features Low-Cost Houses

Precast Concrete Joists and Concrete Slabs in Floors, and Concrete Units in Partitions, Provide Complete Safety Against Fire

IN answer to the demand for a house which will meet the anticipated 35-year expectancy required by the Federal Housing Administration, and which also will be low enough in cost to come within the loan limitations, J. Fletcher Lankton, Peoria, Ill., architect, in conjunction with Emil Zuber, of the Michigan Silo Co., Peoria, has developed a low-cost house at Hilltop Manor, in East Peoria, that is both age-proof and fire-safe.

It was through the use of precast concrete joists and a concrete building block known as "Colonial block" that they have been able to create a home both low in cost and long lived.

The "Colonial" block was developed only recently by the Michigan Silo Co., under the direction of Mr. Zuber. It differs from an ordinary concrete building block only in the fact that the exterior face of the unit is beveled. Thus an 8-in. block will have the usual width at the top, while the bottom will be 8¾ in. wide. This additional thickness appears entirely in the beveled exterior shell.

When this beveled unit is laid up the end joints are given a very thin coat of mortar, so as to make the vertical mortar joints as inconspicuous as possible. Then, when the finished wall is coated with white cement paint, the general effect produced is that of lap siding, well suited to the type of colonial architecture represented by the building here illustrated. Only minor adjustments to block-making machinery are required for the production of this new wall unit.

Mr. Zuber has not attempted to obtain patents on any features of this block, and he has no intention of doing so. He gladly offers it to the concrete products industry.

The architect who designed this building and several others of similar construction did not limit his interest to the exterior wall. Both floors and the attic ceiling are built of precast reinforced concrete joists and cast-in-place concrete slabs, and partitions are built of 4-in. concrete units. The construction of the first floor, as seen from the basement, is shown in Figure 2. The roof framing, alone, is of combustible construction.

Mr. Lankton, the architect, in discussing this question of safety against fire, pointed out how the reinforced concrete joists and floor slabs such as are used in these East Peoria houses are an effective barrier against fires in homes. "Most fires," he said, "break out in the basement; but a concrete floor such as we have built here gives the same protection to occupants of a home as is given to the tenants of a large, fireproof apartment hotel or office building. And here's a curious thing," he continued. "Although many refinements have been developed and are being incorporated into the home, little thought has been given in the past to the protection of this investment against structural deterioration, or against the destructive agencies of fire, vermin, and termites. The homes of tomorrow, through the application of such fire-safe materials as concrete and other non-combustibles, will protect not only the homes but also the people who live in them.

"In this home now being constructed at Hilltop Manor for Theodore Hulter, all of these features have been incorporated at no sacrifice to comfort or convenience," concluded Mr. Lankton.

The "Colonial" block used in the exterior walls of these buildings, as well as the precast concrete joists and partition block, were made of haydite concrete by the Michigan Silo Co., of Peoria.

Concrete Paving in Cold Weather an Established Practice

High-Early-Strength Cement and Integrally-Mixed Calcium Chloride Are Important Factors—Minimum Requirements for Protection

A final covering of straw or hay, on top of curing paper, burlap, or cotton mats, is necessary

THE season for placing concrete roads and street pavements is continually growing longer. In fact, many competent highway engineers are advocating year-round construction of concrete pavements, even in northern states; and they are able to point to any amount of successful cold-weather work in support of their recommendations.

Published Articles Give Procedure

Articles published in CONCRETE during the past year have presented in concise form a complete working procedure for placing concrete pavements in the coldest weather. Readers are referred in particular to two articles—one in the issue of April (1934), pages 18 and 19, by H. F. Clemmer, and another in the May issue, pages 3 to 5, by D. S. MacBride. These two engineers have set forth a definite construction procedure, the former emphasizing the integral use of calcium chloride, while the latter stresses the advantages of utilizing high-early-strength cement.

Specifications for cold weather protection adopted by the Highway Department of the District of Columbia, and involving the use of calcium chloride mixed integrally with the concrete, will be found on page 19 of the April (1934) issue of CONCRETE.

Ohio Sets the Example

The winter paving practice adopted by the Ohio State Highway Department is given in an article on pages 7 and 8 of the January (1934) issue of CONCRETE. In that state high-early-strength cement is used extensively in cold-weather paving work, for the double purpose of shortening the protection and curing period and gaining the advantage of rapid generation of heat during the hardening of the concrete.

The June issue, pages 6 and 7, contains two articles describing winter paving practices in Michigan and Illinois.

High-Early-Strength Cement; Calcium Chloride

In the December (1934) issue, in an article headed "Integral Use of Calcium Chloride Supplies High Early Strength," Mr. Clemmer further amplifies the use of this chemical in winter paving work, pointing out its advantages when used with high-early-strength cement as well as with ordinary portland cement.

Highway engineers will recognize readily the value of both high-early-strength cement and integrally-mixed calcium chloride in connection with concrete paving work in winter. Rapid-hardening cement, as previously explained, shortens the period required for curing (and consequently the length of the cold-weather protection period), while the rapid hardening in itself has the effect of generating heat at a rate sufficient to hold up the temperature of the concrete if it is kept well covered.

Calcium chloride, when mixed integrally with the concrete, has the effect of speeding up the hardening process of the cement, regardless of whether standard or high-early-strength cement is used. In a word, highway engineers may utilize the advantages of rapid-hardening cement and calcium chloride at the same time, thereby making year-round paving an actuality.

Heating Water and Aggregates

It is necessary in all cases, of course, to heat at least the mixing water during cool weather, to heat the mixing water and the aggregates during cold weather, and to keep the concrete well covered during the hardening period.

Minimum heat protection requirements, adapted from the recommendations of the International Cement Corp., are given in the accompanying tabulation. These requirements are based on expected mean temperatures of 50, 33 and 16 deg. F. from sunset to sunrise.

MINIMUM HEAT PROTECTION REQUIREMENTS FOR CONCRETE PAVING WORK

Expected Mean Temperature Between Sunset and Sunrise	Recommended Temperature of Concrete at Mixer	Suggested Method of Protection
50 deg. F.	70 deg. F.	Heat the mixing water. Cover with wet burlap, or equivalent covering, and with 6 in. of straw.
33 deg. F.	80 deg. F.	Cover subgrade with straw. Heat mixing water and aggregates. Cover with wet burlap, or equivalent covering, and with 9 in. of straw.
16 deg. F.	90 deg. F.	Cover subgrade with straw. Heat mixing water and aggregates. Cover with wet burlap, or equivalent covering, and with 12 in. of straw. Cover the straw with canvas.

(Continued on page 24)

How Various Substances Affect Unprotected Concrete

Joint Committee Offers Tabulation of Proposed Protective Treatments—Constructive Criticisms and Suggestions Invited

IN the 1924 Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete there was included as an appendix a tabulation showing the effect of various substances on concrete, and suggested protective treatments where required. The present Joint Committee has reviewed the material in the light of more recent information and has made certain modifications and additions to the original tabulation. At its meeting in Washington, D. C., on December 4 and 5, it was voted to release this material as information. This recent tabulation follows:

SUBSTANCE	EFFECT ON UNPROTECTED CONCRETE	PROTECTIVE TREATMENT
PETROLEUM OILS		
Heavy oils — 30 deg. Baume or heavier	None—Very slight penetration	None
Light fuel oils above 30 deg. Baume	None—Some loss from penetration	Fluosilicate, spar varnish, linseed oil, sodium silicate
Volatile oils—kerosene, benzine, naphtha, gasoline	None — Considerable loss from penetration	Fluosilicate, spar varnish, sodium silicate, phenol-formaldehyde, varnish
COAL TAR DISTILLATES		
Benzol, toluol, xylol and cumol	None—Some loss from penetration	Fluosilicate, sodium silicate, linseed oil, spar varnish
Phenol, cresol, lysol, creosote, carbolineum	Attack concrete slowly	Fluosilicate, sodium silicate, spar varnish, phenol-formaldehyde, varnish
Pitch, anthracene, carbonzol, and paraffin	None	None
INORGANIC ACIDS		
Sulfuric, nitric	Disintegrates	Glass, vitrified brick or tile laid in litharge, lead, rubber. Effective to 150 deg. F. and for 50 per cent sol.
Sulfurous	“	Above group including rubber for all concentration
Hydrochloric	“	“ “ “
Hydrofluoric	“	Lead, rubber effective to 150 deg. F. and for 50 per cent solution.
ORGANIC MATERIALS		
Acetic acid	Disintegrates slowly	Bituminous enamel, phenol-formaldehyde, varnish, spar varnish, rubber
Oxalic acid	None	None
Carbonic (dry) acid	“	“
Carbonic acid in water	Attacks concrete slowly	Asphalt, bituminous, or coal-tar paints, fluosilicate, sodium silicate, spar varnish, phenol-formaldehyde, resin.
Lactic acid	Attacks concrete slowly	Above group, linseed oil, paraffin
Tannic acid	Attacks concrete slowly	Above group
Fish oil	Very slight attack	Fluosilicate, sodium silicate, linseed oil
Lard and lard oil	“ “ “	Above group
Foot oil	“ “ “	“ “
Linseed oil	Slight attack	None
Resin	“ “	“
Cocoanut oil	“ “	Fluosilicate, sodium silicate, linseed oil
Olive oil	“ “	Above group, also spar or bakelite varnish
Rape seed oil	“ “	Above group, also spar or bakelite varnish
Cotton seed oil	“ “	None
Almond oil	“ “	Fluosilicate, sodium silicate, linseed oil, varnish
Poppy seed oil		“ “ “
Walnut oil		“ “ “
Soy-bean oil		“ “ “
Peanut oil		“ “ “
SALTS		
Soluble inorganic salts attack concrete to a greater or less extent in the following order: sulfates, sulfides, nitrates, chlorides, and carbonates		
Sulfates of calcium, potassium, sodium, magnesium, copper, zinc, aluminum, manganese, iron, nickel, cobalt	Actively attacks concrete	Suggested treatments are fluosilicate, sodium silicate, linseed oil, bituminous applications, glass, vitrified brick or tile laid in litharge, cement and rubber
Sulfates of ammonia	Disintegrates	“ “ “
Chlorides of sodium, potassium, calcium, strontium	None	“ “ “
Chlorides of magnesium, iron, mercury, copper, and ammonia	Slight attack	“ “ “
Nitrate of ammonia	Disintegrates	“ “ “
Nitrates of calcium, potassium and sodium	None	“ “ “
Sulfide ores and pyrite	Slight attack	“ “ “
Soluble sulfides except sulfide of ammonia	None	“ “ “
Carbonates	“	“ “ “
Fluorides	“	“ “ “
Silicates	“	“ “ “
Molasses	Slight attack	“ “ “
Sulfite liquor	“ “	“ “ “
Ammonia water	None	“ “ “
Wood pulp	“	“ “ “
Tanning liquors (non-acid)	“	“ “ “
Milk	Attacks slowly	“ “ “
Corn syrup and glucose	Slight attack	“ “ “
Alcohol	None	“ “ “
Silage juices	Attacks slowly	“ “ “

Any one having constructive criticism to offer in connection with the foregoing items, or who wishes to suggest additional items, is invited to communicate with F. R. McMillan, Secretary, Joint Committee, 33 W. Grand Ave., Chicago. Now is the time to offer such criticisms or suggestions, rather than after the new Joint Committee Report is published.

Wetted Cotton Mats Effective for Curing Concrete Pavements

U. S. Bureau of Public Roads Reports Results of Further Tests —Also Provide Protection Against Sudden Overnight Drops in Temperature

DURING the past winter several sets of observations were made at the Arlington Experimental Farm by the division of tests, U. S. Bureau of Public Roads, to determine the effectiveness of cotton mats of various thicknesses when used as a protection against sudden overnight drops in temperature.

A number of small 6-in. concrete slabs were cast with their upper surfaces level with the surface of the ground. In the center of the upper surface of each slab a copper constantan thermocouple was embedded at a depth of ¼ in. One of these slabs was left uncovered while others were covered with cotton filled mats of the following weights:

Designation	Approximate weight of cotton filler in ounces per square yard
A	10
B	30
C	60
D	90
E	110
F	170

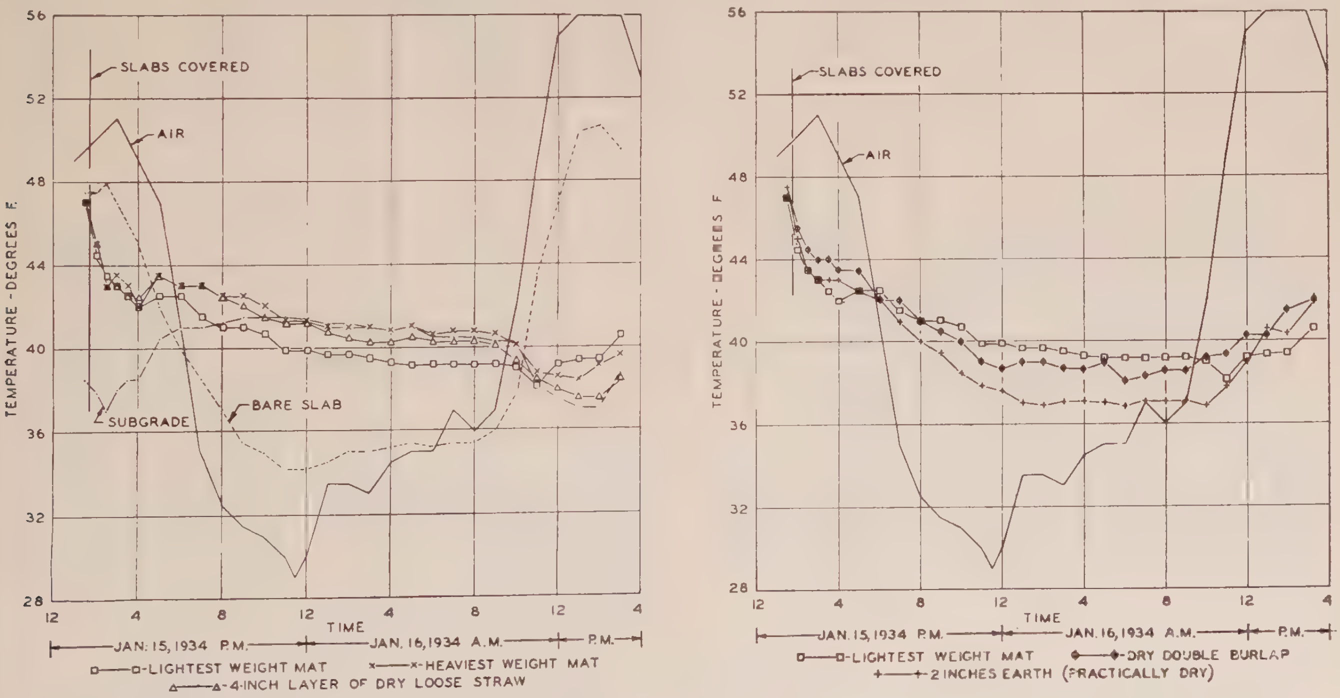
Cotton Mats Give Effective Protection

The mats were made of cotton fiber held in place between sheets of loosely woven covering cloth by stitching or tying. The mats designated as D, E, and F were the 3-, 6-, and 9-ply mats referred to in a previous report.[1]

The slabs were 3 ft. square and the covering mats were made 5 ft. square in order that they might extend beyond the slab edges and thus avoid the possibility of a circulation of air between the mats and the concrete slabs.

In addition to the slabs covered with the cotton-filled mats, and the base slab for comparative purposes, one slab was covered with a double thickness of dry burlap, one with 2 in. of dry earth, and one with 4 in. of dry loose straw. Apparatus was placed to determine the temperature of the subgrade 12 in. below the bottom of the bare slab.

Data were obtained during three periods of observation at times when relatively large drops in temperature occurred. The air temperature fell below 32 deg. F. on only one of these occasions. The temperature cycles of the air, the subgrade, the bare slab, the straw-covered slab, and the slabs covered with the lightest and heaviest weights of cotton-filled mats are shown in the two charts here illustrated, for this most severe case. The diagrams show that the difference in temperature beneath the heaviest and the lightest mats at no time exceed 2 deg. F. The two diagrams shown cover the same test period, the data being separated for the sake of clarity.



Variations in air temperature and corresponding temperatures of slabs with different protective coverings. Both charts cover the same test period, the data being separated for the sake of clarity

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Condensed from report in November (1934) issue of *Public Roads,* published by the U. S. Dept. of Agriculture.

[1] *Public Roads,* July, 1933.

If a protective cover for a pavement slab is to be effective in preventing freezing of the concrete during a sudden drop in air temperature, two conditions must obtain: First, the subgrade must have a temperature sufficiently above the freezing point of the concrete to provide a flow of heat from the subgrade to the slab; and second, the protective cover on the pavement must provide sufficient insulation to insure that the heat will not be dissipated from the slab surface more rapidly than it is received from the subgrade. The absolute amount of insulation required to accomplish this is not a constant, but will dedepend upon the temperature differential existing between the upper and lower sides of the protective cover.

To guard against damage due to an overnight drop in air temperature, from a level of possibly 40 or 50 deg. F. to one of 20 or 25 deg. F., protective covers are most often needed. Ordinarily the temperature of the subgrade is considerably above freezing, the difference between the air and pavement temperatures is not large (from an insulation requirement standpoint at least) and the duration of the sub-freezing air temperature is not protracted. For these reasons the requirements for insulation efficiency are not severe. These facts are rather obvious, but it is well to bear them in mind when examining the data shown in the accompanying diagrams.

Probably the most striking indication of these data is that for overnight drops in temperature where a rise on the following day is to be expected, there is but little difference between the protection afforded by the lightest and heaviest of the cotton-filled mats. Both are effective in holding the slab temperature near the temperature of the subgrade during the period of minimum air temperature. It is also indicated, as would be expected, that in case of a protracted period of subfreezing air temperatures neither mat would provide sufficient insulation to hold the temperature of the slab and of the subgrade above the freezing point.

It is interesting to note the similarity of the temperatures of the slabs covered with the cotton-filled mats with those of the slab covered with 4 in. of dry, loose, straw. Although the differences are small, the straw cover is consistently more effective than the lightest weight mat and less effective than the heaviest mat. The straw cover is also a better insulator than 2 in. of earth. The two sheets of dry burlap offer more protection than the earth and less than the cotton-filled mats. The burlap used was a good grade, rather heavy-weight material and was practically new. Being dry, there was a relatively large amount of entrapped air among the fibers. Had this air been replaced by moisture it is probable that the effectiveness of the burlap cover would have been greatly reduced. No data covering this point were obtained.

These few tests do not provide a basis for definite conclusions, but it is indicated that, for an overnight drop of air temperature to below 32 deg. F., a considerable amount of protection against damage from freezing can be afforded a concrete paving slab by covering with a cotton-filled mat of relatively light weight.

Curing Value of Cotton Mats

In addition to the insulation tests, two series of tests were run to determine the flexural strength at 28 days of mortar specimens cured for 3 days under cotton mats of various thicknesses as compared to the strength of similar specimens cured for 3 days under a double thickness of burlap kept continuously wet. Measurements of the gain or loss in moisture of the specimens at the end of 3 days curing as compared to the original water content were also made. In one series the cotton mats were applied dry, while in the other they were thoroughly wet on one side and then applied with the wet side in contact with the specimen. Wetting was done by means of a spray applied to one side of the mat continuously for 10 minutes. The test procedure was identical with that employed in the tests reported last year and was briefly as follows:

The specimens were of 1:2 mortar, by weight, containing 14 per cent water. They were cast in watertight molds, 11 in. in length, 6½ in. in width, and 2 in. in thickness. The burlap and cotton mats were applied about 2½ hours after molding. At the end of 3 days the mats were removed and the specimens allowed to cure in the air of the laboratory until the age of 26 days, after which they were immersed in water for 2 days and then tested for flexural strength.

Must Keep Mats Wet

The chief purpose of these tests was to compare the curing efficiency of the thinner mats with the comparatively heavy mats (3-ply and over) originally proposed for this purpose. The results obtained from the strength tests disclosed that in all cases the specimens cured with dry cotton mats showed appreciably lower strengths than those cured under wetted cotton mats or under the wet burlap. The wetted cotton mats of lightest weight (*A* and *B*) proved slightly less effective than the wet burlap, while the thickest cotton mats (*E* and *F*) were more effective than the burlap. The average effectiveness for curing purposes was about the same as that of wet burlap.

In consequence of the results obtained, it is recommended that cotton mats, when used for curing, be used under the conditions specified for burlap—that is, they be kept wet during the 3-day curing period. This condition will be compiled with if the cotton mats are wetted once and then placed with the wet side down. Under this condition they are as effective in curing as a double thickness of burlap kept wet continuously for 3 days. This substantiates previously published conclusions.[2]

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[2] See September (1933) issue of CONCRETE, pages 9 and 12.

Robertson Encouraged with Outlook

A. W. Robertson, chairman of Westinghouse Electric and Manufacturing Co. and chairman of the former Committee on Industrial Rehabilitation that accomplished most excellent results through 1932, has just issued an encouraging statement on the outlook for 1935.

"Business and Government are beginning to pull together. The load is beginning to move. As these two forces learn to work in harmony under the new conditions, marked improvement in economic conditions may be expected.

"The fall business of electric manufacturers is the best in three years. Prospects for next year are good."

PULLING JACK FROST'S TEETH!

"To reduce the danger of freezing, I recommended 'Incor'. . ."

Quick-Hardening Concrete Safe from Freezing 2 to 5 days Sooner . . . Heat-Curing Costs 60% to 70% Lower

The quicker concrete hardens the sooner it is past the danger of freezing and the lower the cost of maintaining heat-protection. Because 'Incor' is a better, more thoroughly processed cement, it cures or hardens 5 times as fast as ordinary Portland cement. That is why 'Incor' concrete is safe from freezing 2 to 5 days sooner. Heat-protection costs are 60 to 70 per cent lower. Other savings include earlier form re-use—one form set does the work of several.

It pays to Switch to 'Incor'

Why not figure these savings. It has paid many contractors to switch to 'Incor' with the coming of Winter. Example: In constructing the Administration Building and Hangar for the 26th Div. Massachusetts National Guard, shown above, the engineer says:

"January temperatures were below freezing and building site very much exposed. To reduce danger of freezing, I recommended that the contractor use 'Incor' Cement. Materials were heated and salamanders used after concrete was poured. 72 hours' protection requirement was reduced to 36 hours. Earlier removal of forms saved much lumber; but the real reason for using 'Incor' was to reduce freezing hazards."

Write for New "Winter" Book

Write for free copy of new illustrated booklet, "Winter Construction." It is full of helpful and timely information. Address 'Incor' 24-Hour Cement, Room 2200, 342 Madison Avenue, New York. 'Incor'* is made and sold by producers of Lone Star Cement, subsidiaries of International Cement Corporation, New York; also sold by other leading cement manufacturers.

* Reg. U. S. Pat. Off.

'INCOR' 24-Hour Cement

May Build Fireproof Concrete Homes at Cost of Burnable Construction

ARTHUR C. YOST, a Cleveland architect, has made an analysis of wall costs which bears out the claims of many concrete products manufacturers concerning the low cost of concrete masonry construction. Mr. Yost's analysis supplies further evidence of the folly of continuing the use of wood frame construction for dwelling houses, when fireproof concrete construction may be obtained at less cost.

Single, Double and Triple Concrete Brick

The particular kinds of concrete masonry units used by Mr. Yost in his analyses are the standard size, double size and triple size concrete bricks made on Dunbrik machines, fabricated by the W. E. Dunn Manufacturing Co. Both the double and the triple size units have the same height as the standard brick size, the double unit being 8 by 8 in. in horizontal dimensions, and the triple unit 8 by 12 in. Either the 8-in. or the 12-in. face of the triple unit may be used on the outside face of the wall.

In one of Mr. Yost's analyses he compares an 8-in. wall of hollow-wall ashlar construction with the usual type of exterior wall of wood frame construction. The hollow ashlar wall is built in a manner similar to hollow walls of clay brick, except that triple-size bricks are employed, alternate courses being set on edge and laid flat. The following unit prices and quantities are assumed:

Materials and Labor:	
Concrete face brick, per M	$20.00
Concrete triple face brick, per M	35.00
Concrete triple common brick, per M	25.00
Clay face brick, per M	25.00
Mortar, per cu. ft.	.20
Monolithic glazing, per sq. yd.	.20
Wood studding, per 1,000 b. f.	35.00
Wood sheathing, per 1,000 b. f.	35.00
Siding, per 1,000 b. f.	40.00
Plaster, per sq. yd.	.35
Mason and helper, per hr.	1.75
Carpenter labor, 40 per cent of material cost	
Masonry Units Laid per Day:	
Concrete face brick	600
Concrete triple face brick	500
Concrete triple common brick	800
Clay face brick	600
Clay tile, 5 by 4 by 12 in.	800

From these unit prices Mr. Yost computes the following costs for 100 sq. ft. of wall.

Hollow Wall of Concrete Triple-Size Common Brick	
314 concrete units	$ 7.85
5 cu. ft. of mortar	1.00
Mason labor	5.50
Elaterite plaster base	.85
Plaster, direct	2.77
Monolithic glazing	2.22
	$20.19
Unit price, 20 cents per sq. ft.	

Wood Frame Wall	
234 b. f. studding and sheathing	$ 8.19
164 b. f. of siding	6.56
Paper and nails	.40
Lath	1.10
Plaster	3.89
Carpenter labor	6.50
Paint, 2 coats	4.00
	$30.64
Unit price, 31 cents per sq. ft.	

Similarly, Mr. Yost obtains a cost of 37 cents per sq. ft. for an 8-in. wall of concrete face brick and concrete triple-size common brick back-up (set on edge), and 49 cents per sq. ft. for clay face brick veneer and wood frame back-up.

Again, he obtains a cost of 33 cents per sq. ft. for an 8-in. solid wall of concrete triple-size face brick, and 52 cents per sq. ft. for an 8-in. wall of clay face brick and clay tile back-up, the price of the 5 by 4 by 12-in. clay tile being figured at $38.00 per M.

Why Continue Wasteful Methods?

Exterior 8-in. walls of various types of concrete masonry can be built at a lower cost per sq. ft. than walls of wood frame construction. Likewise, interior partitions of concrete partition units cost less than partitions of wood frame, because of the elimination of lathing in the case of concrete units. These cost advantages gained in walls and partitions may in many cases be enough to offset the admittedly greater cost of floors of precast concrete joists and cast-in-place slabs, as compared with wood-joisted floors. In consequence, no excuse remains for continuing the wasteful habit of building homes of a type of construction that is burnable and requires constant maintenance. It is another national habit that must be broken, in favor of fireproof construction for homes.

Associated General Contractors' Convention to Urge Public Works Program

CONFIDENT that a sustained rise in the volume of construction will restore normal prosperity to the United States, and that this can be attained in 1935 through an intensified application of the methods and experience of the past year, the Associated General Contractors of America will hold its sixteenth annual convention, January 28, 29 and 30, at Washington, prepared to discuss and emphasize the need of a sound and well-rounded PWA program.

Pointing out that because of the functioning of PWA the present year has witnessed the first rise in the annual volume of construction since 1928, Edward J. Harding, managing director of the contractors' national association, states that if the rise can be sustained and continued throughout the coming year to a point at least equal to the construction volume of 1930, a consistent rise in general business indices and the steady absorption of the unemployed will usher in a period of actual recovery.

Taking the report and recommendations of President Roosevelt's National Resources Board in regard to public works as an officially recognized basis for its contentions, the Associated General Contractors' convention will urge the development of a program calculated to encourage the revival of private construction and, at the same time, to fortify it by an underwritten volume of public works sufficient to guarantee the attainment of at least a stipulated minimum of construction activity during 1935.

The convention will be attended by representatives from all fields of general contracting, including building, highway, heavy construction and railroad contractors, from every state and the District of Columbia.

SERVICISED EXPANSION JOINTS

New Cork-Rubber Expansion Joint

In keeping with the present trend toward the resilient types of Expansion Joints our laboratories have produced a new type of Expansion Joint consisting of a composition of cork and rubber. This product makes a very firm and resilient Expansion Joint material. It has been developed to meet the tests and specifications that have been set up by the various Highway Departments as well as the U. S. Bureau of Public Roads.

Rock Surfaced Planking

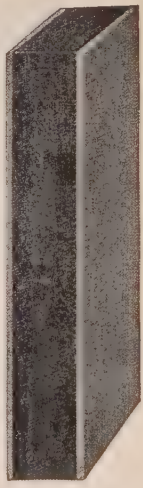
This improvement on Servicised Standard Asphalt Plank has been so well received that today Servicised manufactures half of its production with Rock Surfacing. The particles of wear resistance rock are firmly imbedded in the surface of the plank under tremendous pressure and to a remarkable degree eliminate any possibility of skidding.

SEMENTREAD
Center Road Markings

SEMENTREAD planking in six or eight inch widths is highly adapted for road marking purposes having alternate black and white or black and yellow lines—the lines consisting of Portland cement.

SEMENTREAD is a new skid-proof planking—when laid horizontal to the traffic it promptly stops the forward motion of the car, and when laid vertical to the traffic it stops the side skid as well as forward skidding. SEMENTREAD comprises a cement rib keyed in the asphalt plank surface, which adds rigidity to the surface also making it skid-proof. This material is especially adapted for use on city bridges and viaducts where wet days are a menace to traffic and where short skids are dangerous and cause accidents.

SERVICISED Expansion Joints



SERVICISED Expansion Joints, whether sponge rubber cork, felt sided, or plain composition, excel! SERVICISED Expansion Joints have given service over a period of twelve years, and are found in State highway work in every State in the Union which has used Expansion Joint within this period. You will not be doing justice to your organization without securing prices and learning about these products.

Write today for full information on SERVICISED Products

SERVICISED PRODUCTS CORPORATION
6051 WEST 65th STREET, CHICAGO

Cold Weather Paving

(Continued from page 17)

Watch the Subgrade

When the temperature between sunset and sunrise is expected to fall below the freezing point, the part of the subgrade that is to be concreted the next morning should be covered with 6 in. of straw. The following morning this straw may be sprinkled with gasoline or kerosene, and then burned, thereby removing any light frost that might have occurred during the night. This is a practice that is followed in Ohio.

It is well, however, to avoid finishing the subgrade too far ahead of the mixer. Keeping ahead about a half day's concreting is considered good practice.

◆ CODE NEWS FOR THE INDUSTRY ◆

More Complaint Committees

THE following additional trade-practice complaint committees have been approved by the National Industrial Recovery Board of the NRA:

Cement Gun Contractors Division of the Construction Industry—Conditional approval has been given to a committee to consist of B. C. Collier, Cement Gun Co., Allentown, Pa.; J. M. Crom, National Gunite Contracting Co., New York City; H. Hanna, of Hanna, Zabriskie & Daron, Detroit; B. A. Greene, Gunite Concrete & Construction Co., Kansas City, Mo.; H. H. Hardy, of the H. H. Hardy Co., Fort Worth, Texas; and E. J. Halloran, Cement Gun Construction Co. of San Francisco, Calif.

Aggregates Industry—Trade-practice complaint committees have also been approved for Region 2 and for districts 1 and 3 of Region 1 of the Crushed Stone, Sand and Gravel and Slag Industry.

General Contractor Doing Own Sub-Contracting

A GENERAL contractor who is operating under the code for the general contractors' division of the construction industry does his own masonry work. Does paragraph 3 of administrative order No. X-36, dated May 26, 1934, exempt him from contributing to the expense of administering the code of the mason contractors' division of the construction industry?

The answer is "yes"—the general contractor is exempted from such payment.

Modify Exemptions in Aggregates Industry

PRODUCERS of concrete aggregates (crushed stone, sand, gravel and slag) whose principal line of business is in some other industry are required to contribute proportionately to the cost of administering the code of this industry, except in cases where the average monthly production of aggregates is valued at less than $100. This modification of paragraph (3) of Administrative Order X-36 was made in Order No. 53, recently issued.

Wisconsin Products Men Want State Code

ACCORDING to a recent announcement of the State Industrial Commission of Wisconsin, 69 per cent of the manufacturers of concrete products within the state want a state code of fair competition. The commission declares that most of the opposition comes from the smaller establishments.

A survey made by the commission shows that the sales of the plants in Milwaukee and within 40 miles of that city had only 10 per cent of the business they had in 1929. In the case of 52 identical plants scattered over the state it was found they had an average payroll of $6,041 per week in 1929, compared to $1,254 in 1933.

Field Representatives to Aid Code Authority Members

THE National Recovery Administration has announced plans for placing a trained staff of full-time administration members on national code authorities in the field, to represent adequately the public interest and to aid code authority members in code administration.

Present part-time administration members, under the new reorganization plans, are to serve jointly with the full-time administration members as long as necessary.

Addresses of Code Authorities

FOLLOWING are the addresses of the code authorities of industries and branches of industries related or of interest to the concrete construction industry. When writing to a code authority, include the words "code authority" in the address, thus: Code Authority, Construction Industry, National Press Building, Washington, D. C.

Builders' Supplies Trade, Room 1907—Investment Building, Pittsburgh, Penna.

Cement-Gun Contractors Industry, 5550 Bartlett Street, Pittsburgh, Penn.

Concrete Burial Vault Industry (Chairman of Code Committee is L. A. Chick, care of Blairsville Concrete Products Co., 100 North East Lane, Blairsville, Penna.)

Concrete Masonry Industry, 211 Edgemont Place, Teaneck, N. J.

Concrete Mixer Manufacturing Industry, 221 W. Madison St., Chicago, Ill.

Concrete Pipe Industry, 33 W. Grand Avenue, Chicago, Ill.

Construction Industry, National Press Building, Washington, D. C.

Construction Machinery Distributors Trade, 207 W. Pearl Street, New York, N. Y.

Crushed Stone, Sand and Gravel, and Slag Industry, Munsey Building, Washington, D. C.

General Contractors' Industry, 222 Munsey Building, Washington, D. C.

Portland Cement Industry, 111 W. Washington St., Chicago, Ill.

Ready-Mixed Concrete Industry, 951 Munsey Building, Washington, D. C.

Reinforcing Materials Fabricating Industry, 201 North Wells Street, Chicago, Ill.

Road Machinery Industry, 410 No. Michigan Avenue, Chicago, Ill.

Waterproofing, Dampproofing, Caulking Compounds and Concrete Floor Treatments Industry, 11 West 42nd St., New York, N. Y.

BOOKS On Concrete

List No. 2—Design and Construction, Concrete Making, Cement Manufacture

(Prices quoted are for cash in advance, and include postage)

DESIGN AND CONSTRUCTION OF FORM WORK FOR CONCRETE STRUCTURES. By A. E. Wynn. 320 pages, 219 ills., 12 folded inserts and 11 design tables. Cloth bound, stamped title in gold. Price **$6.00**

"Wynn's Book" is a phrase commonly known to engineers, designers, and foremen, and is heard wherever concrete construction is under way. This book covers every phase of forms for concrete construction, and is fully supplemented with many illustrations, tables and drawings and printed on a superior grade of enameled paper.

CONCRETE CONSTRUCTION MADE EASY. By Leslie Turner and Albert Lakeman. 113 pages, 65 illustrations, 16 tables. Cloth bound. Price **$2.00**

A practical book that solves problems in the design and erection of any type of concrete structure. Full designs with tables and all necessary information for building of foundations, walls, columns, floors, roofs, staircases, beams, water tanks, retaining walls, lintels, formwork, saw-tooth roofs, etc. Written clearly and plainly.

BASIC PRINCIPLES OF CONCRETE MAKING. By Franklin R. McMillan, Director of Research, Portland Cement Association. Ninety-nine pages, 6x9½, 32 illustrations and tables. Price **$2.00**

The author has culled the essentials out of a mass of scientific data on this subject and presents them with force and directness in this book. He shows the effects of quality of material, of proportioning, mixing, working and curing on the finished concrete.

The importance of variable mixes; tests for permeability; how to obtain strength, durability and watertightness; effective ratios; importance of proper construction methods—these and many other vital topics are discussed fully and authoritatively.

GENERAL ENGINEERING HANDBOOK. By Charles Edward O'Rourke and 29 associates. Flexible cover; 921 pages, 5 by 8 in., numerous tables, diagrams, and illustrations. Price **$4.00**

A great amount of fundamental engineering data in usable form, 31 separate sections dealing with as many specific branches of engineering. Of particular interest to engineers who specialize in the use of concrete as a structural material are sections devoted to "Highways," by Thomas R. Agg; "Reinforced Concrete Structures," and "Stresses in Framed Structures," by Charles Edward O'Rourke; "Engineering Materials," by Herbert H. Scofield; "Foundations," by Roland P. Davis; and "Mechanics," by Alfred P. Poorman.

REINFORCED CONCRETE CONSTRUCTION. By George A. Hool, Professor of Structural Engineering, University of Wisconsin.

Vol. I—Fundamental Principles. Third Edition. 380 pages, 6x9, 139 illustrations, 18 tables, 28 diagrams $3.50

Vol. II—Retaining Walls and Buildings. Second Edition. 700 pages, 6x9, illustrated.................. $6.00

Vol. III—Bridges and Culverts, 688 pages, 6x9, over 600 illustrations, 41 plates........................ $6.00

ESTIMATING AND COST KEEPING FOR CONCRETE STRUCTURES. By A. E. Wynn. Published in 1930; 272 pages, 92 illustrations, 2 folders. Price **$5.00**

The author of this book has had a wide experience in contracting for all kinds of concrete structures, and in this volume he publishes his own simple methods of estimating, cost-keeping and book-keeping. Reproductions are given of all blank forms required.

CONCRETE ENGINEERS' HANDBOOK. By George A. Hool and Nathan C. Johnson, assisted by S. C. Hollister, and with chapters by Harvey Whipple, Adelbert P. Mills, Walter S. Edge, A. G. Hillberg and Leslie H. Allen. 800 pages, 6 x 9. Illus. Flexible binding. Price **$6.00**

A compact reference book, containing tables, formulae and data on plain and reinforced concrete, covering the entire field.

CEMENT CHEMISTRY IN THEORY AND PRACTICE. By Prof. Dr. Hans Kuhl, Director of the Institute for Cement Research, Berlin. Translated into English by J. W. Christelow, B.Sc. 64 pages, 6 by 9, cloth cover. Illustrated with a number of halftones and diagrams. Price **$2.50**

An authoritative book on the chemistry of cement, a translation of a series of lectures delivered by Dr. Kuhl in Moscow, at the special request of the Soviet government. The author presents the most up-to-date knowledge of the subject in simple language. The result is a concise record of modern research on the manufacture and setting of cement. Chapter headings are: (1.) The Development of Cement Research; (2.) The Theory of Cement Burning; (3.) The Constitution of Portland Cement Clinker; (4.) The Problem of Hardening and Its Significance in Cement Research; (5) The Chemistry of High-Strength Cements; and (6.) The Technical Aspect of High-Strength Cements.

PORTLAND CEMENT. By A. C. Davis, works managing director, Associated Portland Cement Manufacturers, Ltd. Published in 1934. Cloth, 435 pages, 6½ by 9½ in., 262 illustrations, 22 tables. Price **$8.00**

A new book on cement manufacture, covering more especially the present-day British and continental practices. The author discusses and analyzes such important problems as modern manufacturing methods and organization; formation and nature of cement raw materials; factors governing choice of materials and manufacturing processes; advantages of dry and wet processes; raw material and clinker-grinding problems; improving the efficiency of the rotary kiln; methods of coal feed, slurry drying, and kiln control; reactions in burning cement; rotary kiln heat balances; conservation of heat in rotary kilns; advantages of the purchase of electricity compared with generation at the factory; modern methods of packing and shipping cement; production costs; mineralogy and chemistry of cement.

STANDARD CONSTRUCTION METHODS. By G. Underwood. 408 pages, 330 illustrations. Price **$5.00**

A complete, detailed presentation of actual methods used in practical construction work. A book packed from cover to cover with plans, short-cuts and expedients for construction superintendents and other men upon whom rests the responsibility of getting jobs done quickly and well.

REINFORCED CONCRETE AND MASONRY STRUCTURES. By Hool and Kinne. 722 pages, 6 x 9, illustrated. Price **$6.00**

The work of 14 specialists. This book offers a practical and detailed discussion of every important element entering into the design and construction of concrete and masonry structures. Particularly noteworthy are the very thorough treatments of Reinforced Concrete Buildings, Concrete Forms, Chimneys and Concrete Detailing.

HELPS TO SUCCESSFUL CONTRACTING. By Harry O. Locher. Published in 1934; 222 pages, 5½ by 8 in. Price **$2.00**

An unusual book for contractors, covering every phase of the work from estimating and bidding to cleaning up and moving to the next job. Written by an author with more than 30 years of experience in the contracting business. Every contractor and construction superintendent or foreman should have a copy.

WINTER CONSTRUCTION METHODS. By Charles S. Hill. Cloth, 180 pages, 6 by 9 in., illustrated. Price **$3.00**

This book assembles in one volume the practices found most effective in carrying on concrete construction work in cold weather. Subjects treated in individual chapters include construction of concrete bridges, roads and street pavements in winter; use of special cements in cold weather; heating of materials; handling and placing concrete; protectig concrete in heavy sections; progressive canvas housing for building construction; and use of complete enclosures.

SPECIAL COMBINATION OFFER: $1.50 (or $2.00 for Cement Mill Edition) added to the price of any of the above listed books will entitle you to one years subscription to Concrete or extend your present subscription one year from its present expiration date. Foreign and Canadian subscribers please write for details.

Book Department of CONCRETE, 400 West Madison Street, Chicago, Illinois

HOW TO DO IT

Questions and Answers
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Calcium Chloride Not Harmful to Steel Reinforcement

A letter from a subscriber in Austria expressed interest in the fact that calcium chloride is used in reinforced concrete work in the United States. In Austria, he said, it is not so used. His question was referred to Ray A. Giddings, secretary of the Calcium Chloride Association, 4200 Penobscot Building, Detroit. The paragraphs that follow comprise Mr. Giddings' discussion of the subject.—Editor.

The following data, taken from reliable and non-commercial sources, definitely prove that calcium chloride used as an admixture in concrete does not cause corrosion of reinforcing steel.

A report presented before the American Society for Testing Materials as to the condition of steel rods imbedded in concrete test specimens, containing calcium chloride, for a period of six years states that "The majority of people would pass upon the steel rods as being entirely satisfactory. Corrosion is absent over the greater portion of the surfaces of the rods, what rust occurred being localized apparently where voids occurred on the surface of the steel. Comparison of the one-year and five-year specimens indicate that corrosion is not progressive."—(J. C. Pearson, Physicist, Bureau of Standards, A. S. T. M. 1923.)

An examination of mesh reinforcing imbedded in concrete pavements in Pennsylvania for at least eight years, in which 2 and 4 per cent respectively, of calcium chloride had been used as an admixture, showed the steel to be in first class condition and in as good condition as that in plain concrete.—(Pennsylvania State Highway Department, Harrisburg, Pennsylvania.)

A recent report of an investigation started five years ago by the Canada Cement Company stated that "Corrosion was found only on the steel imbedded in the dry mixed concrete. None was found in the mortar mixed to 125 per cent consistency, which is about the usual consistency used in construction of reinforced concrete. . . . The condition of the steel in both plain and calcium chloride specimens has been found almost exactly the same in the specimens examined each year for the past four years. The steel in the majority of specimens examined was found bright and clean." Cottringer and Kendall found after one year no corrosion of 3/4-in. bars in 6 by 6 by 24-in. concrete specimens mixed with 0 to 10 per cent commercial calcium chloride (dihydrate).—(CONCRETE magazine, 1923, 22 (4) 150-5.)

The presumption that calcium chloride incorporated in a concrete mix may have an effect on the corrosion of steel placed in the concrete is undoubtedly due to the fact that calcium chloride is a salt. However, the steel is not subjected to the effects of calcium chloride as a salt, but rather to a mass of concrete in which has been included a small percentage of a salt that has been neutralized by the cement, which is a strong alkaline material. Tests show that the addition of calcium chloride, in percentages recommended for use in concrete, does not change the alkalinity of the cement paste, which indicates its identity as a salt disappears when added to the concrete.

Manufacture of Precast Reinforced Terrazzo Slabs

We have developed a hollow floor construction for which we are required to manufacture marble mosaic or terrazzo slabs ranging from 15 by 15 in. up to 24 by 24 in., with thicknesses from 1¼ to 1½ in.

These slabs will act as pavement, and since they are to be laid on a hollow floor they must be reinforced. From our experience as manufacturers of ornamental concrete tile we are of the opinion that the cheapest and quickest way to produce these slabs would be under hydraulic pressure on hydraulic presses. There is a danger, however, that under such pressure the reinforcement may react, or spring, thereby creating something in the nature of a horizontal crack. This would have a tendency to divide the terrazzo slab into two distinct layers.

Can you recommend a method of manufacture through which this difficulty may be avoided without adding too much to the cost of production?—P. H. A., Bombay, India.

It is quite possible that in manufacturing these slabs under hydraulic pressure, you might run into difficulties such as you fear. This seems quite clearly a case where the best method of placing and compacting the concrete is by means of high-frequency vibration.

In this connection you will be interested in an article published on page 15 of the January, 1934, issue of CONCRETE, the article being entitled "Many Uses for Vibrating Equipment in Cast Stone Plant."

Vibrators producing high frequencies of low amplitude have been developed, to puddle and compact stiff concrete. Most equipment gives at least 3,000 impulses per minute. Some produce much higher frequencies. The vibrating elements most commonly used are (1) an electric motor with an unbalanced member, (2) a reciprocating cylinder operated by compressed air, (3) an unbalanced shaft driven by motor or engine, (4) an electric magnet pulsator, (5) an air-driven motor with an unbalanced member, or (6) a gasoline engine with unbalanced fly wheel. Electricity, compressed air or gasoline may be used for power.

Table vibrators, in which vibrating elements are attached to the under side of a table on which molds are placed, are used to manufacture cast stone, precast concrete joists, and other products. The use of gang molds permits casting and vibrating a number of products at one time.

Coming Conventions

***January 5-13*—St. Louis Modern Home Exposition.** Exhibition Hall. St. Louis Municipal Auditorium. Lincoln G. Dickey, Director.

***January 16-18*—American Society of Civil Engineers.** Annual. Geo. T. Seabury, Secretary, 33 West 39th St., New York City.

***January 22-25*—American Road Builders' Association.** Convention and Highway Exhibit. Willard Hotel, Washington, D. C. Chas. Upham, Engineer-Director, National Press Building, Washington, D. C.

***January 27-February 2*—National Crushed Stone Association.** Annual. Palmer House, Chicago. J. R. Boyd, Secretary, Munsey Building, Washington, D. C.

***January 27-February 2*—National Sand and Gravel Association.** Annual. Palmer House, Chicago. V. P. Ahearn, Executive Secretary, Munsey Building, Washington, D. C.

***January 27-February 2*—National Slag Association.** Annual. Palmer House, Chicago. H. J. Love, Manager, Earle Building, Washington, D. C.

***January 28-30*—Associated General Contractors of America.** 16th Annual. Washington. E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

***February 16-24*—Chicago Modern Homes Exposition, Inc.** Coliseum. H. H. Potts, Manager, 1 N. LaSalle St., Chicago, Ill.

***February 19-21*—American Concrete Institute.** Thirty-First Annual Convention. Roosevelt Hotel, New York City. Harvey Whipple, Secretary, 7400 Second Blvd., Detroit, Mich.

Chicago's Modern Home Exposition

THE Chicago Modern Home Exposition, in co-operation with the Federal Housing Administration, the Chicago Real Estate Board and the Chicago Federation of Labor, will open Saturday, February 16, at the Coliseum (16th & Wabash) and continue through Sunday of the following week.

More than 250 manufacturers and dealers are expected to be represented with 350 exhibits of products allied with the building industry.

Experts in various phases of modernization and home furnishings are scheduled to speak at the sessions. Luster to the festivities will be added by the participation of stage, screen and radio notables.

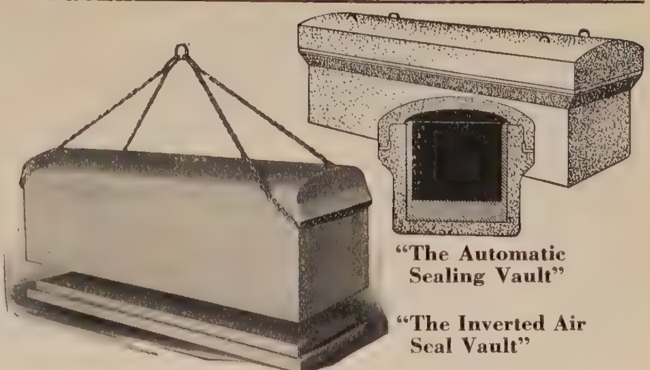
Reviving Building Industries

The major factor in the building and construction outlook for 1935 is the support which the Government will give to this activity in its program to stimulate business and employment.

The Government's emphasis on the revival of building and construction is very logical because it will greatly aid the depressed heavy industries and thus become an important factor in further sustained business recovery.

Rents have shown the first upturn this year since 1924. An increase of more than 5 per cent has occurred so far.

These three paragraphs are from the December 15, 1934 BROOKMIRE ANALYST.



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You already have mixing and curing facilities. All you need is the mold. It costs comparatively little. Only one is needed for all common sizes of each style of vaults. All you do is manufacture and deliver. Your selling is done for you by a plan that has stood the test of time.

Probably no other business offers so much return for the amount of money invested. Compare the profits with the outlay. We will send you the stories of men who have made money from the "Automatic Sealing Vault." It is free. It puts you under no obligation. Write for it now.

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UNIFORMITY
In Concrete
Is Assured by Using
BARNSDALL ADMIX

The concrete sections of minimum strength determine the strength of the structure as a whole, regardless of the strength shown by cylinder tests. A chain is no stronger than its weakest link. Honeycombed sections do not show up in cylinder tests and are the weak links in concrete. Eliminate the weak links and increase the minimum strengths by obtaining uniformity with a low water-factor siliceous admixture of high purity.

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Light-Weight Aggregate

For All Uses Where Light Weight Concrete Is Advantageous

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Necessary parts to convert Anchor Floor Type Tampers to Double Bar or 8-Drop type, particularly desirable in making 12″ blocks or two 4″. Save cement and make more uniform blocks.

Prompt shipments of accurately Universal machined parts for all Anchor, Hobbs, Universal and Ideal machines.

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Stearns Mfg. Co. **Adrian, Michigan**
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GIANT PORTLAND CEMENT COMPANY
Pennsylvania Building, Philadelphia, Pa.
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CONCRETE SPECIALTIES—How to Make and Sell Them

A 64-page booklet, entitled "How to Make and Sell Concrete Specialties," was published by the Concrete Publishing Company in 1928, and was distributed quite extensively throughout the concrete products industry.

Individual chapters cover the following subjects: (1) Analyzing the market for concrete specialties; (2) concrete burial vaults; (3) concrete septic tanks; (4) concrete fence posts; (5) concrete sills and lintels; (6) concrete silo staves; (7) concrete roofing tile; and (8) concrete floor tile.

A limited number of copies of the booklet, just made available, can again be offered to readers of "Concrete" while the supply lasts, at the reduced price of 50 cents a copy, which is half the publisher's price of $1.00.

Orders should be addressed to

Book Department of CONCRETE
400 West Madison St. **Chicago, Illinois**

New Books and Pamphlets

Concrete Cottages and Bungalows

CONCRETE COTTAGES, BUNGALOWS AND GARAGES. By Albert Lakeman and T. Raffles Davison. Third edition, rewritten and revised. Published by Concrete Publications, Ltd., London, S. W. 1, England. Cloth, 136 pages, 6½ by 9½ in. Numerous illustrations. Available through the Book Department of CONCRETE at $2.50.

Several designs for cottages, bungalows and garages, each with variations, have been prepared by the author for construction in concrete, either monolithic or with concrete masonry units. For each design the book contains all the information necessary for its erection, including plans, elevations, cross-sections, and perspective drawings, showing the same designs with flat and pitched roofs. Detailed bills of material are given.

From the architectural point of view the designs with pitched roofs are attractive, following the well-known English cottage style. The flat-roof designs are less satisfactory, because of the monotony of the unbroken roof lines.

A. S. T. M. Tentative Standards

BOOK OF A. S. T. M. TENTATIVE STANDARDS (1934 Edition). This publication, issued each year by the American Society for Testing Materials, is the only volume containing all of the A. S. T. M. tentative specifications, methods of test and definitions of terms covering engineering materials and the allied testing field. These tentative standards, issued as proposed standards, embodying the latest thoughts and practices, find important applications throughout industry.

The 1934 edition of the Book (1,250 pp.) contains 236 tentative standards. Of these, 48 are included for the first time, while some 60 were revised this year and are given in their latest approved form.

Copies, in cloth binding at $8.00 each or in heavy paper cover, $7.00, can be obtained from A. S. T. M. Headquarters, 260 S. Broad Street, Philadelphia, Pa.

The Great Earthquake in India

THE GREAT INDIAN EARTHQUAKE is the title of a special issue of *The Indian Concrete Journal*, published in the Forbes Building, Home Street, Bombay, India.

This special issue, which appears as the October (1934) number of this journal, contains a full description and numerous illustrations of the widespread destruction caused by the great earthquake which occurred in Bihar on January 15, 1934. Illustrations are from photographs taken shortly after the earthquake.

Conclusions drawn from the effect of the earthquake are in marked agreement with lessons taught by other major earthquakes—namely, that continuous, monolithic and well braced construction is necessary to resist earthquake forces. Reinforced concrete structures proved by far the most resistant type.

Form Details

CONCRETE FORM DETAILS, for free distribution to contractors, have been issued in loose-leaf data sheet form by the Universal Form Clamp Co.

Contractors who are not receiving these details, and wish to get them, should address a request to CONCRETE. Such requests will be promptly forwarded.

ORGANIZATIONS

American Association of State Highway Officials; W. C. Markham, Executive Secretary, 1222-24 National Press Building, Washington, D. C.

American Chemical Society, Mills Building, Washington, D. C.

American Concrete Institute; Harvey Whipple, Secretary, 7400 Second Blvd., Detroit, Mich.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

American Institute of Chemical Engineers, Bellevue Court Bldg., Philadelphia, Pa.

American Railway Engineering Association; E. H. Fritch, Secretary, 59 East Van Buren St., Chicago, Ill.

American Road Builders' Association; Chas. Upham, Engineer-Director, National Press Building, Washington, D. C.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 West Thirty-Ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 260 S. Broad St., Philadelphia, Pa.

Associated General Contractors of America; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

Building Officials Conference of America; Wm. F. Hurd, Secretary, Room 203, City Hall, Indianapolis, Ind.

Calcium Chloride Association, 4200 Penobscot Bldg., Detroit, Mich. R. A. Giddings, Secy.

Cast Stone Institute; C. G. Walker, Asst. Secy., 33 West Grand Ave., Chicago, Ill.

Cement Institute; H. C. Lundborg, General Manager, 11 East 44th St., New York City.

Concrete Reinforcing Steel Institute; R. W. Johnson, Secretary, 201 N. Wells St., Chicago, Ill.

Engineering Institute of Canada; 2050 Mansfield St., Montreal, Quebec.

Highway Research Board; Roy W. Crum, Director, 2101 Constitution Ave., Washington, D. C.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Concrete Masonry Association; Horace W. Bush, Secretary and Treasurer, 211 Edgemont Place, Teaneck, N. J.

National Crushed Stone Association; J. R. Boyd, Secretary, 449 Munsey Bldg., Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Managing Director, 60 Batterymarch St., Boston, Mass.

National Highway Users Conference, Roy F. Britton, Director, National Press Bldg., Washington, D. C.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; V. P. Ahearn, Secretary, 545 Munsey Bldg., Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 545 Munsey Bldg., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, Earle Building, Washington, D. C.

National Terrazzo and Mosaic Association; J. M. Fuhrman, Secretary-Treasurer, 524 Brook Street, Louisville, Ky.

New Jersey State Concrete Products Association; Horace W. Bush, President, Lyndhurst, N. J.

Portland Cement Association; Edward J. Mehren, President; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary; Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

Wire Reinforcement Institute; R. D. Bradbury, Director, National Press Bldg., Washington, D. C.

Wisconsin Concrete Products Manufacturers' Association, Inc.; L. E. Schwalbe, Secretary, Wauwatosa, Wis.

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Extra profits can be made even in these days of "Hold down costs!" Adding color to a concrete structure adds little to its cost yet justifies an additional profit. The profit may take the form of closing the contract against competition rather than a slightly higher price. Either way color makes money for you.

Make sure you use Anchor and Star Colors. They never change. Their purity makes them most economical. Their uniformity assures perfect results. They are easy to handle. A sample will be sent you for the asking. Write for our free boooklet.

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20th & Lynch Ave., East St. Louis, Ill.
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Plain Pallet Strippers pay for themselves in first cost and in operating cost as they make an endless variety of concrete units upon a single set of inexpensive plain Pallets. Now available at any price and capacity desired and with improved features.

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Ask us about attachment for making the new oscillated waterproof cinder units

ECONOMY DOUBLE HEADED NAIL

Invaluable for concrete form work. You can drive them home and they hold much more tightly than the ordinary nail. Nails can be withdrawn and lumber and nails used over many times. Hold fast but pull easily. Let us send you half dozen nails to try out with your own hammer. Just drop a line to—

THE F. A. NEIDER CO., Inc.
Augusta, Kentucky

EQUIPMENT AND MATERIALS

SUPER-COLORSEAL, a rubber-base colored finish—a new development by the Master Builders Co., Cleveland, Ohio—is offered after two years of research, as a practical method of painting basement floors in residences, stores, churches, also for power houses and other concrete floor areas lying directly on the ground.

A Moistureproof Seal Coat is first applied to the floor. Super-Colorseal is applied with a brush 24 hours later. Moisture penetration from below is stopped, they say, and the Super-Colorseal finish is tough and especially resistant to scuffing.

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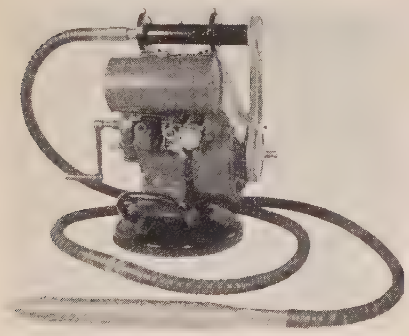
WHITE concrete vibrators in two models have been announced for national distribution by O. E. Quinton, vice-president and general manager of the Superior Construction Equipment Co. of Indiana, Inc., Chicago, Illinois.

The two new concrete vibrators are both driven by gasoline engines but electric motors may be furnished if desired, the makers state. The new Model M-1 is provided with 2 h.p. Lauson engine, mounted on free swiveling base, with 2⅜ in. diameter vibrator. The Model M-2 has a 4 h.p. Lauson engine and wheelbarrow mounting with 12 in. x 3.50 single pneumatic tire, and 3½ in. diameter vibrator.



The White concrete vibrator

Both vibrators give from 3,800 to 4,000 pulsations per minute.

Several new and improved features are embodied in these machines, according to Mr. Quinton. The engines are operated at much reduced speed to insure longer life and lower maintenance cost. The high vibration rate is obtained through a V-belt speed step-up and ball bearing belt-adjusting counter shaft.

Mr. Quinton reports that an investigation by the United States Bureau of Public Roads shows that numerous states already require vibration of concrete and that 26 states consider the use of vibration as advisable under certain conditions.

•

THE HKP Swivel Head Cutter works up or down, right or left, behind or before, in or out, because the cutting head swivels to any angle on either side of the handles (from nothing to a right angle).

H. K. Porter, Inc., Everett, Massachusetts, claims this tool works just as effectively in any of these positions as does the rigid type Porter tool.

A special section joined by a ball and socket joint, with a shoe for holding the cutterhead and a positioning spring to hold the head in the desired position, are all the changes employed.

Porter's swivel head cutter

The shoe will hold any standard head of a given size, clipper cut, center cut, chain cutter, nut splitter, etc., and the change from one head to another can be made in a jiffy and on the job.

A kit can also be had by which a standard Porter tool can be made into this universal Swivel type at small expense.

•

SERVICISED Cork-Rubber Expansion Joint is a new type of expansion joint consisting of a composition of cork and rubber, recently announced by the Servicised Products Corporation, Chicago, pioneers in the expansion joint field. Many developments and patents have been contributed by this organization and this new cork-rubber type has been developed in keeping with the present trend toward resilient types of expansion joints. This new product, they say, makes a very firm and resilient expansion joint material, and meets all the tests and specifications that have been set up by the various highway departments as well as the Bureau of Public Roads.

Servicised Products Corporation also announces a new road marking longitudinal center joint, to be built in as a part of the pavement. Continuous traffic quickly wears away road marking paints. This new longitudinal center joint comes in the form of a dummy longitudinal joint set into the pavement about 2½ in. It is a pre-formed plastic product having center ribs of a white cement which causes a perfect, as well as permanent black and white marker, clearly visible to automobilists, they say, thereby decreasing the possibility of accidents that might otherwise occur. The cost of this product is at a par with other types of center joints.

Manufacturers' News

JOLTCRETE taken over by Gene Olsen. Many readers who attended the annual meeting of the American Concrete Institute and the Concrete Masonry Association in Toronto last February will recall the Joltcrete machine exhibited by Louis Gelbman, of Joltcrete, Inc., Yonkers, New York. This machine has now been taken over by Eugene F. Olsen, General Manager of the Stearns Manufacturing Co., Adrian, Michigan, who is redesigning it along somewhat heavier lines and says he will soon have it on the market.

The machine is a simply-built, low-cost unit, operated by one man, thereby providing flexibility in the operation of a plant. A high-frequency vibrating attachment is set into action as the concrete is entering the molds.

Industrial Literature

JAEGER Lakewood Equipment is the title of a new and very complete condensed reference catalog for all products of the Jaeger Machine Company of Columbus.

There are three sections, covering construction machinery, truck mixers and road machinery.

On the inside front cover is a quick index of the various pumps, mixers, hoists, placing equipment, truck mixers and road machinery.

New Type of Super Plywood for Better Concrete Forms

Changes in Manufacturing Process Increase Strength, Durability and Smoothness—Thoroughly Waterproof Product Suitable for Permanent Outdoor Use

A REVOLUTIONARY new type of plywood of special interest to the concrete construction industry has just been perfected by the Harbor Plywood Corporation of Hoquiam, Washington, according to announcement made by the president of the company, A. R. Wuest.

The new panels offer the same plywood advantages of large size and smooth surfaces, but are stronger, more durable and practically proof against warping or separation. These qualities enable it to be re-used many times more than regular plywood, consequently cutting costs still further.

"The new product, which is known as Harbord Super Plywood," explains Mr. Wuest, "is constructed in an entirely different manner from former types of plywood. Its manufacture starts in the same way, with thin sheets of wood to be placed together with the direction of the grain alternating. But instead of these sheets being joined with wet glue and kept under pressure in stacks for hours until the glue sets, a dry glue film composed of natural resin is used. Each panel is individually pressed between hot plates under extreme pressure, so that the intense heat permanently fuses or welds the layers of wood to each other. This is known as the Nevin process, from J. V. Nevin, chemical engineer with the Harbor organization, who perfected it. The process is exclusive and is protected by patents."

The great advantage of this super plywood, according to Mr. Wuest, is its resistance to moisture, which makes it adapted to all outdoor uses, such as roofs, side-walls, outdoor signs, etc., opening a field that has been practically closed to plywood. Where ordinary plywood has been outstandingly successful for concrete form material, the new product promises to be even more acceptable to architects and contractors. For this purpose it will be known as Harbord Super Ply-Crete.

"The hot-prest panels have a satin-smoothness of surface," he states, "and their low moisture content greatly decreases warping, checking or grain raising. Because the Nevin resin binder is non-abrasive, it does not affect the cutting edges of tools. In looking at the edge of the finished panel it is almost impossible to see any evidence of the presence of an adhesive between the plies. Yet so strongly are the plies united that the most severe tests have failed to produce any separation.

"Other specific advantages of this new plywood of importance in many industrial uses are its greater flexibility, increased insulation, resistance to molds, fungi and insects which will not attack or penetrate the Nevin resin binder, greater fire resistance and greater ease in handling and working."

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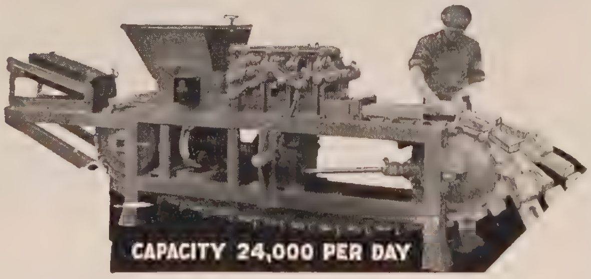

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Vol. XLIII
No. 1

Cement Mill Section of
Concrete

JANUARY
1935

Clinker-Heat Recuperators Reduce Fuel and Grinding Costs

Improve Grindability of Clinker, Increase Quantity of Fines and Raise Strength of Cement—Are Indispensable Pieces of Equipment

WHEN one considers that the heat carried out of a rotary kiln by the clinker amounts to about 200,000 B.t.u. per bbl. of clinker, equivalent to around 15 to 20 lb. of coal, the importance of recovering and utilizing that heat becomes fully apparent.

It is not surprising, therefore, that engineers have devoted much time to the problem of utilizing this heat in the most effective manner, at a reasonable cost. Efforts in this direction have attained commercial success within the past five years.

Preheating Air of Combustion

In all of these developments the heated air from the cooling clinker has been utilized mainly as secondary air of combustion in the rotary kiln from which the clinker came, though in most of the new types provision is made for utilizing a part of the recovered hot air to preheat the primary air of combustion.

A second advantage with these newer developments is found in the more complete burning of the clinker, because of the preheated condition of the air of combustion.

Still another feature common to all of the newer types of cooler is that the clinker is cooled much more rapidly than is possible with the old type of rotary cooler. This rapid cooling in itself results in several extremely favorable effects. It is the direct cause of improved grindability, of a larger proportion of sub-sieve fines, and of greater strength in the finished cement. In consequence, the saving in fuel, though constituting the principal aim and amounting to the principal item of economy, does not comprise the only source of saving. A saving results also from the reduced power consumption in grinding the clinker, while still further economy is gained in the fact that a smaller tonnage of coal needs to be handled, dried and pulverized.

It may be stated that the old type of rotary cooler in unmodified form is a thing of the past, so far as new installations and replacements are concerned, whether the heat released by the clinker is recovered or not.

Separate and Integral Coolers

Several of the newer types of cooler, it is true, consist of separate units, placed in a relation to the kiln similar to that of the old rotary cooler. But these newer units are not rotary. Instead, beds of clinker are moved along slowly over grates, currents of air being forced up through the clinker and absorbing the heat, this heated air, or a part of it, being returned to the kiln.

Several others of the newer types, known as "integral" coolers, are installed in the lower end of the kiln itself as an integral part of the kiln. This type may, in fact, be regarded as a prolongation of the kiln, although kilns in which these units are installed are not actually lengthened. In one well-known cooler of this type the last 8 or 10-ft. length of the kiln is simply appropriated for the installation of the necessary mechanism, while the pipe

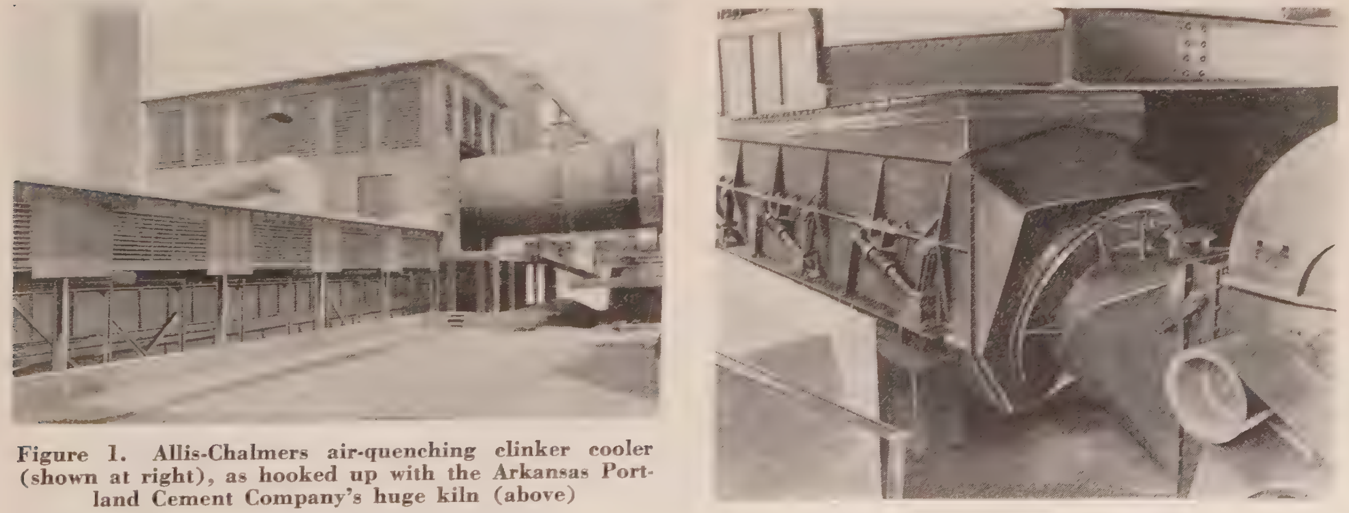


Figure 1. Allis-Chalmers air-quenching clinker cooler (shown at right), as hooked up with the Arkansas Portland Cement Company's huge kiln (above)

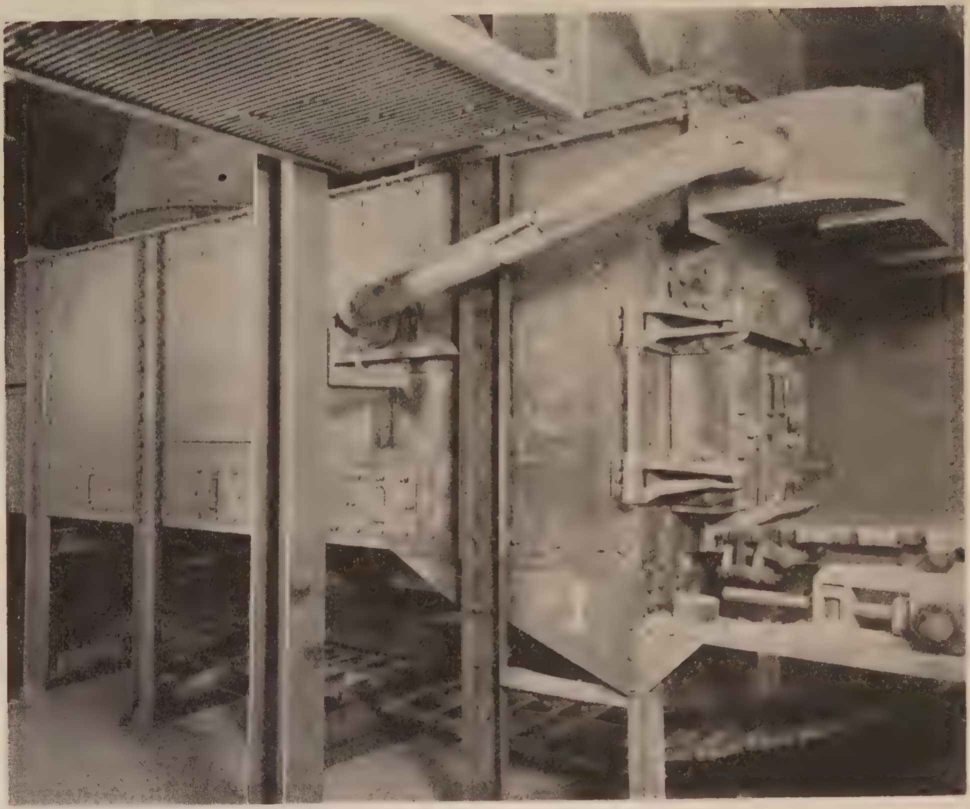


Figure 2. Lee process clinker cooler, as installed at Oglesby plant of Marquette Cement Manufacturing Co.

carrying the primary air blast and the kiln fuel is lengthened by the necessary amount to carry it through and past the cooling apparatus.

Thus it is seen that the newer coolers are of two general types—namely, the separate unit utilizing a grate over which a bed of clinker is slowly moved, and the integral unit, installed in the discharge end of the rotary kiln itself.

Clinker leaves the kiln at a temperature of from 2,000 to 2,200 deg. F. An efficient cooler will deliver it cool enough to be handled, at the same time heating the air for combustion to about 700 deg. F.

The Allis-Chalmers Cooler

A highly successful example of the separate cooling unit is that known as the air-quenching type, developed by the Allis-Chalmers Manufacturing Co., of Milwaukee. The first commercial installation of this unit, illustrated in Figure 1, was made at the plant of the Arkansas Portland Cement Co., at Okay, Ark., early in 1933. This cooler unit, 4 ft. 6 in. wide and 80 ft. long, is set at right angles to the 11 ft. 6 in. by 300-ft. kiln with which it is hooked up.

This Allis-Chalmers cooler consists of an upper stationary housing, fully insulated; and below this a reciprocating housing equipped with grates carries the bed of cooling clinkers. Both housings are approximately rectangular in section. An air passage is in the space below the grates in the lower housing. Air from a blower passes into this housing and goes up through the grates and through the agitated bed of clinker, where it absorbs heat from the clinker and passes into the stationary housing above. These hot gases in the stationary housing are then either delivered direct to the kiln to serve as secondary air of combustion, or they are mixed with the gas fuel being delivered to the kiln. It will thus be seen that the primary, as well as the secondary, air of combustion is preheated. Excess air near the discharge end of the cooler, which is comparatively cool, is sent out through a stack or a ventilator. The record of performance attained at the Arkansas plant includes the following:

(1) The fuel consumption of the rotary kiln has been reduced from approximately 1,800 cu. ft. of gas per bbl. of clinker, to 1,600 cu. ft. per bbl., representing a saving equivalent to approximately 200,000 B.t.u. per bbl. of clinker.

(2) The capacity of the clinker-grinding mills, when grinding to the same fineness as previously, increased 25 per cent. There was, of course, a corresponding reduction in power required for grinding.

(3) The clinker obtained after the new cooler was in operation produces cement having greater fineness and a considerably higher early strength. Increased strengths average approximately 20 per cent on the 24-hr. tensile test, and 15 per cent on the 7-day tensile tests.

The economy in fuel alone constitutes a saving that fully justifies the cost of the installation.

The Lee Cooler

Another cooler that is installed as a separate unit is known as the Lee process clinker cooler, shown in Figure 2 and produced by the Cement Mill Equipment Co., of Detroit. This illustration is a general view of the feed end of the cooler, as installed at the Oglesby plant of the Marquette Cement Manufacturing Co. Eleven units of this type were installed in 1931 and 1932 at Marquette's two plants, at Oglesby, Ill., and Cape Girardeau, Mo.

The Lee cooler is a compact unit, divided into three compartments separated by bulkheads containing swinging gates.

In the bottom of the cooler is a fixed grate, over which a slowly-moving drag-chain conveyor drags the bed of cooling clinker at a normal speed of 3 ft. per minute. The depth of the bed of clinker is from 6 to 8 in.

The first compartment of the cooler is simply the inlet chamber that receives the hot clinker as it falls from the discharge end of the kiln. The second compartment is that from which the insulated air flue seen in the upper left part of the illustration (Figure 2) conducts the recovered hot air back to the kiln, where it is utilized as the secondary air of combustion. The air in the third compartment has a temperature of only about 150 deg. F., and it is wasted through stacks, though it still has a temperature sufficiently high to be useful for other purposes, such as drying coal or supplying heat for a building.

The position of the bulkhead between the second and third compartments determines the size of the second compartment, and this in turn determines the volume of air returned to the kiln. The position of this bulkhead, therefore, is adjusted to meet the requirements in each case.

The first and second compartments are, of course, heavily insulated; but, in addition, they are completely surrounded by a jacket which captures the heat radiated through the compartment walls and ceilings, and this additional hot air is drawn out by a primary fan. The heat thus reclaimed is used to raise the temperature of the primary air stream. Results of the Marquette installations include—

(1) A fuel saving of about 15 per cent is believed to be attributable to the clinker coolers, an additional saving of about 5 per cent being due to the installation of new kiln ends, new hoods, and improved methods of coal feeding.

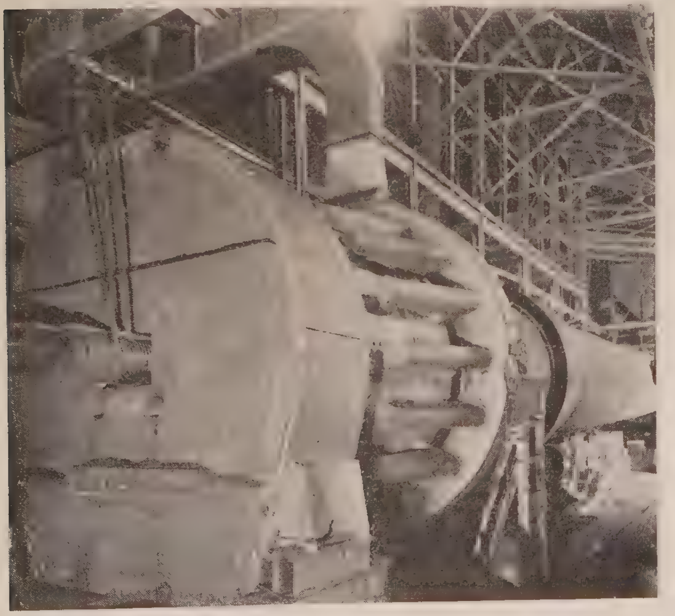


Figure 3. Vanderwerp heat recuperator, as installed at the Kosmosdale plant of the Kosmos Portland Cement Co. This installation is integral with the kiln, at the discharge end

(2) The rapid cooling of the clinker has resulted in structural changes which greatly enhanced its grindability.

(3) Higher early strength, due to the greater degree of fineness. The surface area of cement from the rapidly cooled clinker averaged 17 per cent greater than formerly.

A new clinker cooler of a type similar in a general way to that of the Lee cooler, but utilizing more recently developed principles, is in a well-advanced stage of development, and may be announced within the next few months. The cost of this installation is expected to be low.

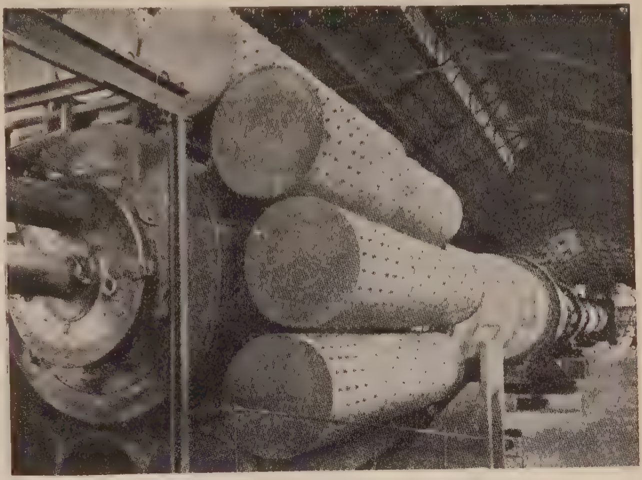


Fig. 4. A European development—subsidiary cooling tubes around circumference of kiln shell

The Vanderwerp Integral Recuperator

An integral clinker cooler which the manufacturer prefers to call a heat recuperator is known as the Vanderwerp type, developed by H. Vanderwerp, vice-president of the Medusa Portland Cement Co., working in conjunction with the Manitowoc Engineering Works, of Manitowoc, Wis.

The first Vanderwerp installation—at the Manitowoc (Wis.) plant of the Medusa company—was, in fact, built into the old rotary coolers. This installation is still giving a very creditable performance; and the same can be said of several other installations of a similar nature. But later experiments proved that the recuperator would be even more effective if installed within the kiln itself. All of the more recent installations are of this newer type, including the most recent of all—at the Kosmosdale (Ky.) plant of the Kosmos Portland Cement Co. Two of the six kilns at the Kosmosdale plant, each 8½ by 125 ft., were thus equipped in the summer of 1934.

The Vanderwerp recuperator as a whole (see Figure 3) consists of an annular wind-box surrounding the kiln near the discharge end, through which an air blast is forced by a fan, the air passing through manifolds to metal liner plates. These liner plates consist of four rows carried on alloy-steel subframes, and they cover the entire inside of the shell of the kiln for a longitudinal distance of 8 ft., though in the most recently installed units the plates are spotted on centers that leave a clear space between them.

The entering air passes through tuyere openings in the metal liner plates, entering the kiln under some pressure, the main air blast entering immediately under—and passing through—the bed of hot clinker. This entering air—all of it—thus becomes the secondary air to support com-

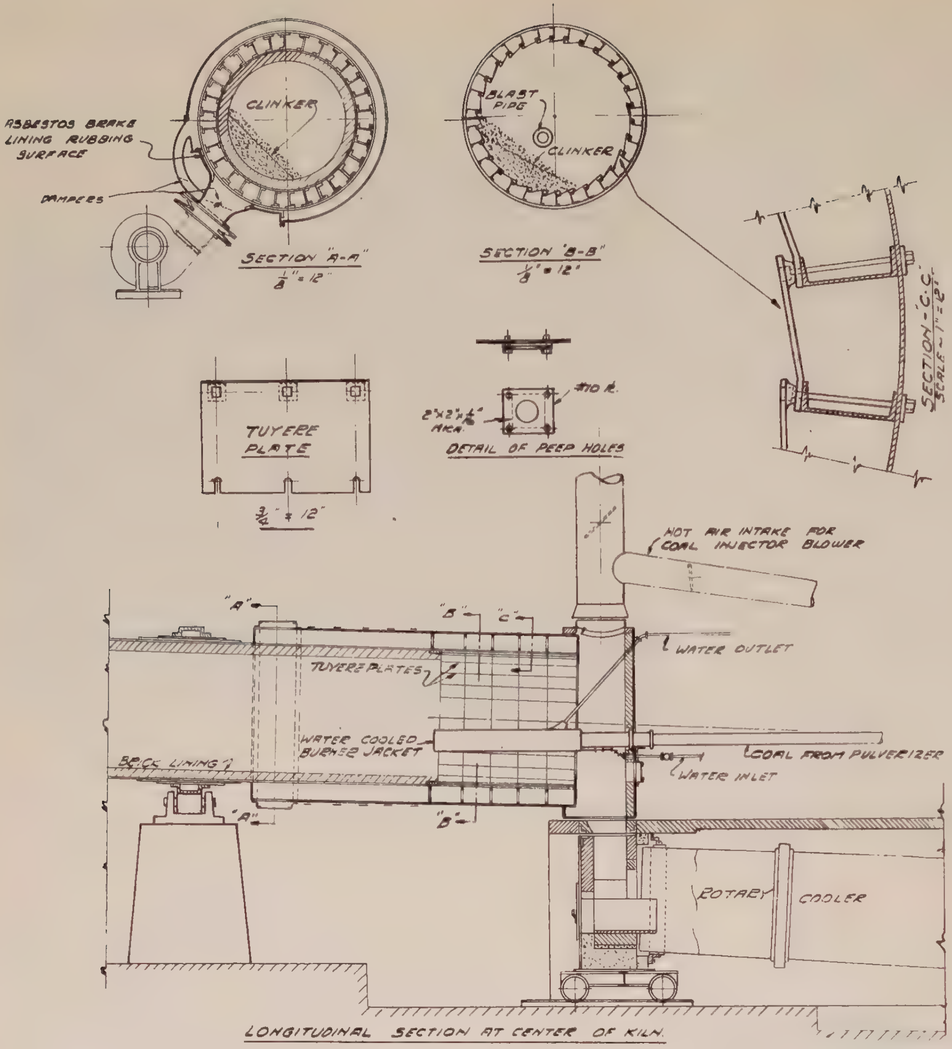


Fig. 5. The Buckbee clinker cooler installed integrally with the kiln at the discharge end

bustion. The kiln operator controls the volume of air entering the kiln by regulating the fan that supplies it. He maintains a slight positive pressure in the discharge end of the kiln, thereby preventing the entrance of cold air around the kiln hood.

It will be seen that the Vanderwerp recuperator is of much simpler construction, and doubtless much lower in cost, than some of the integral clinker coolers developed in the European cement industry (see Figure 4) in which the designers have provided a number of subsidiary tubes for cooling, arranged around the circumference of the shell of the rotary kiln at its discharge end for a length of around 20 ft.

Results obtained from the Vanderwerp installations in two of the kilns at the Kosmosdale plant may be summarized as follows:

(1) As with others, the principal saving is in fuel. Compared with the previous fuel requirements of these two kilns, a saving of some 250,000 to 275,000 B.t.u. per bbl. of clinker has been realized.

(2) The clinker in these two kilns is exceptionally well burned, being hard and vitreous. Because of this more complete burning, the company uses these two kilns to burn its super, or high-early-strength, cement.

(3) The grindability of the clinker is greatly improved, resulting in reduced power requirements per bbl. of cement, in this department.

The Buckbee clinker cooler, developed by J. C. Buckbee, vice-president of the Petoskey Portland Cement Co., has been taken over by the Springfield Boiler Co., Springfield, Ill., for manufacture and installation.

This cooler, like the Vanderwerp, is designed for installation within the discharge end of the kiln, as an integral part of the kiln shell. Neither of these types is expected to cool the clinker to a handling temperature ready for grinding, but rather to a temperature of around 750 to 800 deg. F., just below the margin between black and dull red. The primary purpose is that of saving fuel by recovering and utilizing in the kiln itself the greater part of the heat absorbed by the white-hot clinker, and to gain the improved quality of clinker resulting from rapid cooling.

With the Buckbee cooler the discharge end of the kiln is replaced by what is called a new air-preheating section which is composed of a series of tuyere plates fastened to channel irons, which in turn are welded to the kiln shell. Around the channels is a steel shell, extending from the end of the kiln to a stationary steel air duct. There are openings in this outer steel shell under the stationary air duct, and, as the kiln revolves, air is forced through these chambers formed by the channel irons and the outer shell to the front tuyere section. The source of this air current is a fan located on the floor, which forces the air through the stationary steel duct previously mentioned. Openings of 1 in. underneath each of the tuyere plates permit entry of the air current into the kiln. These tuyere plates are shown in Section B-B and the large-scale section in the upper right part of Figure 5.

Section A-A, in the same drawing (Figure 5) shows the dampers that control the air supply. Through this control of the volume of air entering the kiln, the operator is enabled to cool the clinker to any desired temperature within reason.

The stack on top of the hood of the kiln (Figure 5) controls, by means of a damper, the surplus air that is not needed as secondary air to support combustion. This surplus air is drawn through the intake extending from the stack to the right, and is used to preheat the primary air stream.

In mills that are equipped with the older type of rotary coolers, the clinker, cooled to a temperature of around 800 deg. F., drops from the kiln to the rotary cooler. If the mill is not equipped with rotary coolers, a secondary cooler is installed to complete the cooling process to the temperature required for grinding.

New Lehigh Valley Plant to Start Operations in February

National Portland Cement Company's Plant Approaching Completion—Two 372-Ft. Kilns to Provide Daily Capacity of 3,600 Bbl.—Most Modern Equipment Installed

THE new plant of the National Portland Cement Company, now approaching completion at Brodhead, in the Lehigh Valley district of Pennsylvania, is expected to start manufacturing operations on or about February 15, 1935. Actual construction work was started last February. All the buildings, with one exception, are now under roof, and all major machinery units are on their foundations and ready to be tuned up preparatory to the actual start of operations.

Wet-Process Operation

The initial capacity of the plant will be 3,600 bbl. daily. Provision has been made for doubling or trebling this capacity to meet market conditions. The quarry has been opened and now presents a good working face of high-calcium limestone and Lehigh cement rock. The mineral deposits cover an area of several hundred acres which has been thoroughly drilled and prospected, proving ample rock material for the manufacture of the best grades of portland cement.

Only eleven major units will be required in the rock crushing, raw grinding, clinker grinding, coal grinding, and kiln departments.

The wet process of manufacture will be used. The arrangement for slurry handling, blending, and storage

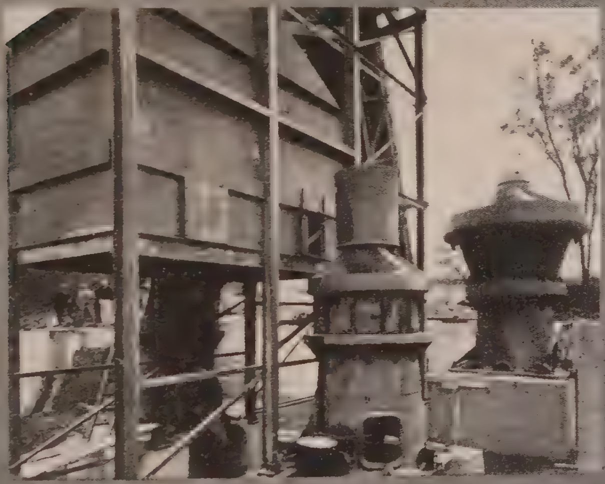


Figure 1 (Above). Installing the crushing plant

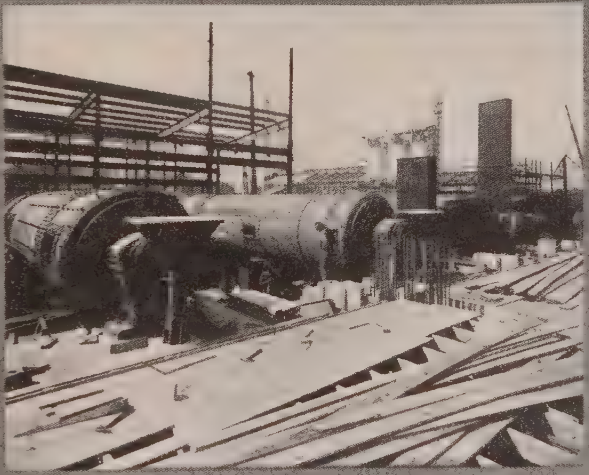


Figure 2 (Above). Raw mills and clinker-grinding mills

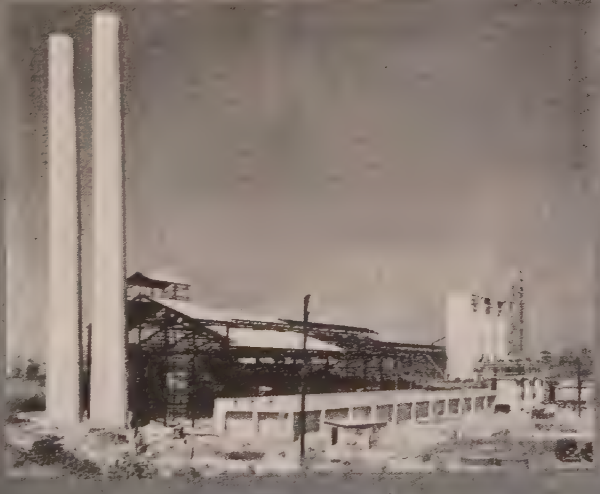


Figure 3. The kiln building; slurry silos and basin

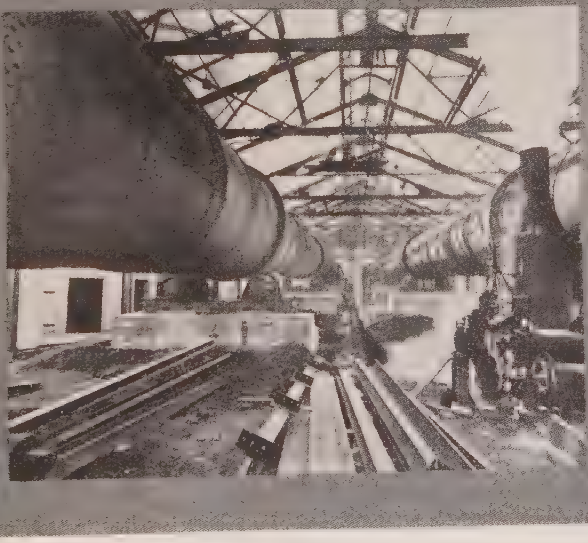


Figure 4. The kilns are 10-ft. in diameter and 372 ft. long

equipment is such that the control of the raw cement mixture will be absolute.

Quarry and Crushing Facilities

The quarry is equipped with Pawling & Harnischfeger electric shovels, Vulcan Iron Works gasoline locomotive, and Atlas Car & Manufacturing Company 10-ton quarry cars, which will be spotted at the crusher by means of an electric hoist.

The crushing equipment consists of primary and secondary gyratory crushers made by the Kennedy-Van Saun Manufacturing & Engineering Corporation. The crushed stone is delivered to the raw mill bunkers or to the rock storage by means of 36-in. Jeffrey belt conveyors. Stone in storage is recovered by a Pawling & Harnischfeger overhead traveling crane, which serves the raw, clinker, and coal grinding departments.

Most Modern Grinding Equipment

The Unidan mills in the raw, clinker, and coal grinding departments were manufactured by F. L. Smidth and Company. One of the features is the high speed motors connected to F. L. Smidth symetro gears driving the tube mills, and employing exclusively the closed system of grinding. The slurry is pumped from the Unidan mills to the slurry silos by means of Wilfley pumps. The slurry is agitated by means of air and a combination of air and mechanical mixers.

Cement is transported from the cement mills to the cement stock house by means of Fluxo pumps, made by F. L. Smidth & Company. The cement transported from the cement stock house to the packing house is handled by Fuller-Kinyon pumps, made by the Fuller Company, who also furnished all the rotary air compressors.

The two Unax kilns are each 10 ft. in diameter and 372 ft. long, and were made by F. L. Smidth & Company. They are fired by pulverized coal. As previously indicated, the coal is pulverized in Unidan mills fitted with drying compartments which are supplied with hot air from the clinker coolers for drying the coal.

The coal-handling equipment includes a track hopper, conveyor, and crusher, made by the Jeffrey Manufacturing Company. The coal, clinker, cement, and gypsum elevators are made by the Link Belt Company.

Storage Capacity of 250,000 Bbl.

There are 25 cement storage silos, each 25 ft. in diameter and 85 ft. high, with a capacity of 250,000 bbl. Adjoining is a 4-story cement packing house. The cement will be packed by Fluxo packers, made by F. L. Smidth & Company. Provision is made for bulk loading.

A steel water tank of 50,000 gallon capacity and 100 ft. high is provided to give a constant water pressure throughout the plant and for all the water-cooled bearings. An ample supply of water is obtained from Monocacy Creek and from deep wells.

Provision for Emergency Power

The main switchboard is located in the mill building, where two 300-kw. direct-connected motor generator sets are installed, one of which will be direct-connected to a 400-hp. gas engine to furnish the plant with positive lighting and power for turning the kilns during any power interruption from the source of supply—the Metropolitan Edison Company.

The electrical equipment in the sub-station and throughout the plant was made by the Westinghouse Electric and Manufacturing Company. Power from the Metropolitan Edison Company will come into the plant over two separate lines, entering at 33,000 volts. All motors will be either 2,300 volts or 440 volts.

Facts About Buildings

A completely equipped machine shop and a store room are provided to take care of plant requirements.

The clinker bins, stone bins, gypsum bins and coal bins are built entirely of reinforced concrete.

The raw storage building, 80 ft. wide and 550 ft. long, will be completely covered.

The kiln building is covered with corrugated asbestos sheathing. The mill building is partially of concrete brick. The crusher building and rectangular slurry basin are roofed with protected metal, aluminum color. The transformer building is of concrete brick with a gypsum roof, and is equipped with ventilators with side wall louvres.

Acknowledgments

The general contractors are the M. A. Long Company, of Allentown, Pa., and Baltimore, Md. These same contractors built the Keystone Portland Cement Company plant, in the same vicinity.

The plant was designed by, and is being constructed under, the personal supervision of Fred B. Franks, Vice-President and General Manager, who has constructed four other plants in the Lehigh Valley.

A. P. Hachtmann is the Chief Engineer, and is in charge of details in connection with the construction of the plant.

William M. Richardson is President of the National Portland Cement Company. The executive offices are located at 420 Bourse Building, Philadelphia, Penn. The plant office is located at Brodhead, Northampton County, Penn.

New Books and Pamphlets

Economics of Organic Chemistry

The Farm Chemurgic, by William J. Hale, research consultant for the Dow Chemical Company. Published by the Stratford Company, Boston, Mass.; 201 pages, 5 by 7¼ in.

It must be admitted that this book is not directly concerned with the manufacture of cement; but its treatment of the economics of the chemical industry is so illuminating that every cement chemist will find it full of interest. After explaining how the one-sided development of inorganic chemistry in this country resulted in the decline and final fall of the agricultural industry, the author shows how organic chemistry is slowly but surely coming to the rescue.

Refractories Plants in United States

Refractories Plants of the United States. Map and chart compiled by J. H. H. Muirhead and issued by the American Refractories Institute, Philadelphia, Penna.

The general map shows the location of every plant, the states of Pennsylvania, Ohio and Indiana being shown also in a larger scale. Tabulations give the name and location of each individual company.

EDITORIAL

The Hundred Million Mark

The portland cement industry should round out the old year with total shipments of at least 77,000,000 barrels, compared with 64,086,000 barrels shipped in 1933, thus showing an increase of 20 per cent in the year just closed.

Increased highway construction, expansion of PWA activities, housing construction under the stimulant of the FHA, and increased industrial construction are among indications of a greater demand for portland cement in 1935.

An increase of 30 per cent over 1934 will again carry the industry across the mark of 100,000,000 barrels. The best observers agree that this mark will be reached—and passed.

Good Omen for 1935

A favorable promise for the cement industry in 1935 is seen in the manner in which shipments held up during the later months of the year just closed.

It is quite unusual for shipments of portland cement in October to equal the highest monthly level of the year; but October, 1934, made that record, with shipments practically up to the totals for May and June. Not until November did the seasonal drop get under way—several months later than usual.

There is agreement on all sides that the construction outlook promises a distinct advance in 1935, as compared with 1933 and 1934. While the situation is too complicated to justify a quantitative estimate of the expected gain for the coming year, authorities predict a substantial increase.

The cement industry, therefore, may expect a definite increase in shipments in 1935—an increase which may have been foreshadowed by the improved volume recorded in the early autumn months of 1934.

To Generate or Buy Power

Whether power for a cement plant should be generated at the plant or taken from public utility power lines is a question that has often required painstaking analysis before a decision could be reached. Each case presented its own particular problems, and in most cases the decision had to be made without the benefit of complete information.

A. C. Davis, a British authority on cement manufacture, offers the general principle that when power requirements are less than 1,000 kilowatts it will be found more expedient and economical to buy power, provided, of course, that industrial power is available at a reasonable price. For loads above 1,000 kilowatts, the installation of generators may be justified if a cheap supply is not otherwise available.

Regarding the size of a plant requiring as much as 1,000 kilowatts, the late Richard K. Meade places the average power requirement for manufacturing cement at from 1.0 to 1.5 installed horsepower for each barrel of daily capacity. Thus, a mill making 1,000 barrels daily would require generators having a capacity of 1,000 to 1,500 horsepower, or 750 to 1125 kilowatts. Conversely, a plant utilizing 1,000 kilowatts may have a daily capacity ranging somewhere from 750 to 1,125 barrels.

While these are only general principles, they will serve as a starting point.

Reducing Costs with Clinker Heat

The discussion of installations for the recovery and utilization of clinker heat, in the leading article in this issue, shows that a modern type of clinker-heat recuperator comes rather closely to being an indispensable piece of equipment in economical cement mill operation.

The saving in kiln fuel, the improved grindability of the clinker, and the higher quality of the finished product—all of which are well-established results of the installations described—are gains that are too important to be ignored. Cement men who have had experience with the actual operation of these newly developed cost-reducers agree that they pay for themselves in a very few years—that the complete capital outlay involved in their installation may quickly be written off.

Thus far the principal purpose for which the recovered clinker heat has been utilized is that of preheating the secondary air of combustion and the primary air stream. But not all the heat given off by the cooling clinker is needed for this purpose, so that some of it is wasted.

The surplus heat that remains unutilized in some of the installations described might, in some cases, be used to dry coal if the coal-drying equipment is not so far away as to make such use impractical. This use is, in fact, suggested. It is significant that the new cement plant now under construction in the Lehigh Valley district, also described in this issue, is designed to utilize the clinker heat for drying coal as well as for preheating the primary and secondary air of combustion.

In view of the marked saving and improved quality made possible by modern clinker-heat recuperators, and in further view of the moderate cost of several of the most efficient types, no plant should continue operations without them.

Dehydration of Calcium Aluminates

Report of Investigation Presented before French Academy of Sciences—Testing Apparatus Described

The report here presented is translated from an article by Jacques Lefol, in Le Ciment (Paris), and originally presented before the Academy of Sciences in October, 1933.

THE writer has undertaken a study of the dehydration of the following calcium aluminates:

$Al_2O_3.4CaO.12H_2O$, investigated by H. Le Chatelier.

$Al_2O_3.3CaO.21H_2O$ (needle crystalline form), investigated by Travers and Schnoutka.

$Al_2O_3.3CaO.6H_2O$ (cubic), investigated by Thorvaldson.

$Al_2O_3.2CaO.7H_2O$, investigated by H. Lafuma, Assarson and Forsen.

The writer has employed the method developed by M. Guichard. In that procedure, an ordinary balance is used, carrying on one end of its scale beam a wire-glass tube, to the lower part of which is attached a cup containing the substance to be dehydrated. This cup is placed within an electric furnace in which, by means of an appropriate arrangement, it is possible to cause a uniform rise in temperature from 20 to around 350 deg. C. within an interval of 5 hours.

The other extremity of the scale beam carries a glass tube submerged in a small tank of oil, the contents of which it is possible to vary at will. The addition of oil permits compensation—because of pushing down the tube —for the loss of weight suffered by the substance being heated.

If one traces a curve, taking the temperatures as abscissas, and taking as ordinates the number of molecules of expelled water, for each hydrate, there is found to exist a more or less brusque drop in the slope of the curve.

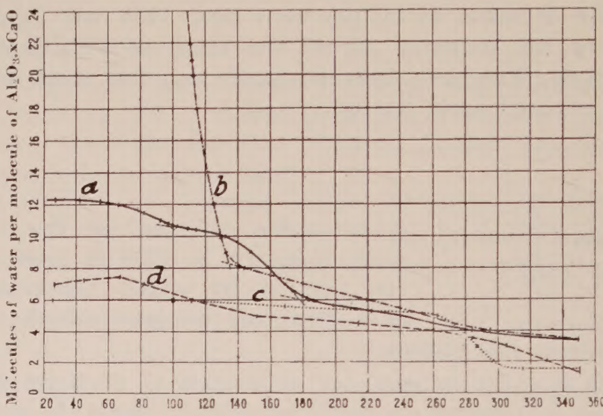
The following results have been obtained:

(1) For the hydrated tetracalcium aluminate, shown as curve *a*, it will be seen that at about 95 deg. C. the hydrate contains between 10.5 and 11 H_2O. At a temperature of around 175 deg. C. the hydrate contains 6 H_2O per molecule of $Al_2O_3.4CaO$. It will be observed that the last remaining molecules of water are difficult to eliminate, because at 350 deg. C. the aluminate still contains a little more than 3 molecules of water per molecule of $Al_2O_3.4CaO$. It is nearly as much for the other aluminates.

(2) For the first of the hydrated tricalcium aluminates, shown graphically as curve *b*, nothing is at first seen on the curve that would indicate any particular influence on the hydrate which would tend to disturb the 21 molecules of water. This proves, without doubt, that the original substance was very wet, and that, under the influence of heat, it reaches the composition $Al_2O_3.3CaO.21H_2O$ at the temperature of 110 deg. C., the temperature at which this hydrate is probably no longer stable. At 135 deg. C., on the contrary, the curve clearly shows a hydrate containing between 8 and 8.5 H_2O per molecule of $Al_2O_3.3CaO$.

This result is a close approach to that obtained by Travers and Schnoutka, who have ascertained that upon drying $Al_2O_3.3CaO.21H_2O$ in a vacuum over sulfuric acid and caustic potash, this hydrate lost water very rapidly down to 12 molecules of H_2O.

(3) For the cubic hydrated tricalcium aluminate, one ascertains, from the curve *c*, the initial stability of this hydrate at 6 H_2O, and the later formation (between 260 and 310 deg. C.) of a hydrate containing 1.5 H_2O per molecule of $Al_2O_3.3CaO$. These results are in accord with those obtained by Thorvaldson.



Curve *a* = hydrated $Al_2O_3.4CaO$
Curve *b* = hydrated $Al_2O_3.3CaO$
Curve *c* = hydrated $Al_2O_3.3CaO$ (cubic)
Curve *d* = hydrated $Al_2O_3.2CaO$

(4) For the hydrated dicalcium aluminate, it is observed on curve *d* that up to 65 deg. C. the hydrate, starting with 7 H_2O, gained nearly half a molecule of water per molecule of $Al_2O_3.2CaO$. In fact, the writer has observed that when placed in an atmosphere saturated with moisture, this hydrate gained about one molecule of water in 15 minutes and about 2 molecules in 4 hours.

At 65 deg. C. the dehydration started, and at 150 deg. C. there is a hydrate containing 5 molecules of H_2O per molecule of $Al_2O_3.2CaO$.

From the Patent Office

Portland cement manufacture: Harry McCaig Larmour & Stephen C. Pierce, Jr., Merced, Calif. U. S. Pat. 1,976,132.—The process of maintaining desired residual water content in portland cement while grinding comprises grinding the clinker in a mill at an internal pressure above atmospheric pressure maintained by means of a gas blast into the end of the mill in opposition to the draft of the mill.

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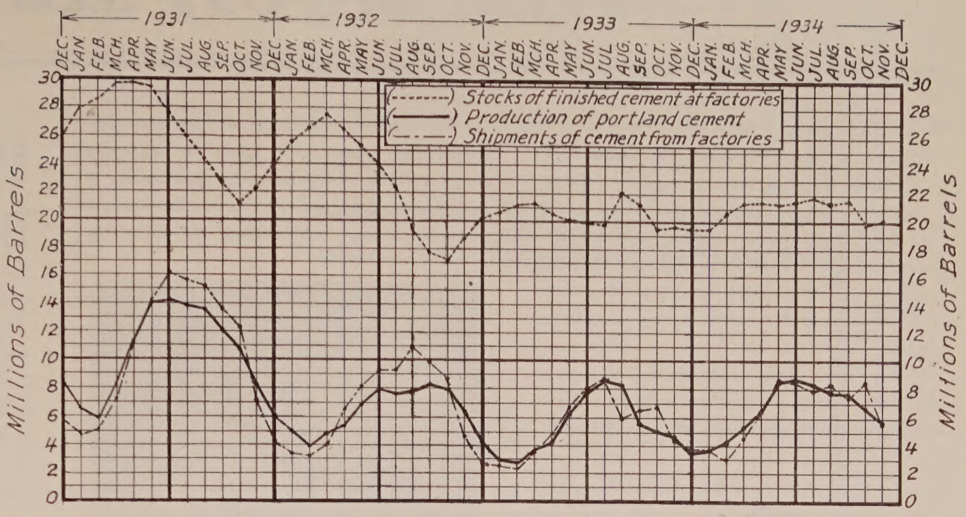
Process of grinding portland cement: H. M. Larmour, Merced, Calif. U. S. Pat. 1,976,133.—The process of grinding portland cement comprises introducing water to the grind in the mill in amount sufficient to overcome evaporation loss through heat of grinding and retain from .5 to 4% of the water in the finished product.

Cement Statistics for November

PRODUCTION of portland cement in November, 1934, showed an increase of 23.7 per cent and shipments an increase of 26.9 per cent, as compared with November, 1933. Portland cement stocks at mills were 1.9 per cent higher than a year ago.



Relation of Production to Capacity (Per Cent)

	The Month	Twelve Months
November, 1934	26.2	28.7
November, 1933	21.2	23.9
October, 1934	29.3	28.3
September, 1934	34.8	27.6
August, 1934	34.5	26.8

Production, Shipments and Stocks of Finished Portland Cement (Barrels)

	1933	1934
Production, November	4,672,000	5,779,000
Shipments, November	4,463,000	5,664,000
Stocks at end of month	19,709,000	20,086,000
Production for year to date	59,847,000	73,235,000
Shipments for year to date	60,348,000	72,803,000

American Institute of Chemical Engineers in Twenty-Seventh Annual Meeting

By J. C. WITT

STATISTICS enthusiasts are responsible for the statements that the twenty-seventh annual meeting of the American Institute of Chemical Engineers, held at Pittsburgh from November 15 to 17, was the largest fall meeting the Institute has ever had, that it was the second largest Institute meeting for all time, and that the ratio of the registration to the membership of the local section was very high. But still more impressive evidences of the unexpectedly large attendance were that the Hotel Schenley, headquarters of the meeting, was compelled to refuse reservations a week or two in advance of the convention, and at the first session in the main ballroom many persons stood until bell boys could rush chairs to them. Pleasing as the attendance was to the Institute and the Pittsburgh section, its principal significance is as an indication of improving conditions in professional activities.

The program announced an address of welcome by Hon. John F. Fisher, former Governor of Pennsylvania, and the address was actually made by Mr. Fisher. This was an unusual experience to the writer, and it seemed to be a good omen for the success of the meeting. As a rule the mayor or other high official who is to make the address does not appear, but sends an associate to represent him.

After the welcoming had been completed in a most interesting and hospitable manner, the first technical session began. The three mornings of the meeting were devoted to such sessions, two being held simultaneously on Friday morning. Two afternoons were given over to plant inspection trips. The banquet was held in the University Club on Friday evening, the guest speaker being Arthur Brisbane. He repeatedly told his audience how little he knows about science and technology, but nevertheless he revealed the far-reaching scope of his general information.

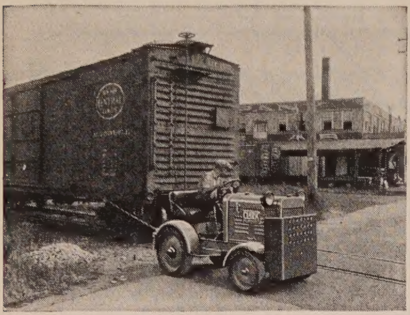
Papers, discussions, and inspection trips covered a wide range of technology. While there was no theme common to them all, the writer was particularly impressed by the developments in heat application and conservation, and the time and effort that manufacturers are devoting to studying the characteristics of their products and developing new uses for them. Apparently no tonnage is too large or too small to receive attention, and the long established use of a material for a special purpose is no assurance that it will not be replaced by a competing material at any time. Of the many interesting papers delivered the following may be mentioned:

(1) Some New Sulfur Cements, by Werner W. Duecker
(2) The Inductive Heating of Process Equipment, by Robert D. Center
(3) Photography and Chemical Engineering Research, by Walter Clark
(4) Refractories and Their Applications, by W. F. Rochow
(5) Some Polar Characteristics of Electrical Insulation, by C. F. Hill
(6) Quantitative Evaluation of Mixing as the Result of Agitation in Liquid-Solid Systems, by A. W. Hixson and A. H. Tenney

MILL EQUIPMENT

CLARKTOR-6, a new all-purpose industrial tractor, in three models—is announced by Clark Tructractor Company, Battle Creek, Michigan. "Clarktor-6" has a 46 h.p. 6-cylinder power plant, and its designers claim for it an efficiency hitherto unknown in industrial tractors—a pound of drawbar pull for every pound of tractor weight.

Heavy duty Clark transmission and special gear ratios in double reduction rear axle make a wide range of speeds available to handle various types of service—speeds as high as 18 m.p.h. This is important in plants and grounds covering large acreage where speed of operation has an important bearing on the tractor's earning capacity. All models have self-starter, generator, battery, electric horn, front bumper plate, eye coupler, pneumatic tires. Lights are available on all models, to facilitate night operation. Gaspower makes 24-hour uninterrupted service possible. Included in the extra equipment available are dual pneumatic or solid tires, special couplers, Clark condensing muffler, speedometer, front fenders.



The Clarktor-6

Three models comprise the line—"Light" for general industrial use; "Speed" especially suitable for airport, hangar and country club service and "Heavy" for the tougher towing assignments, such as steep grades for trailer trains and the bothersome spotting or shifting of freight cars on plant sidings.

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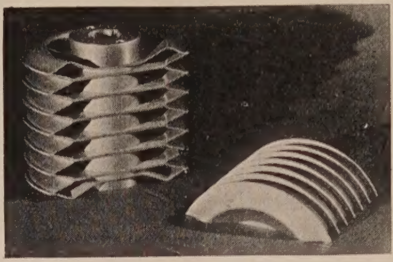
DURO-BRACE Texsteel Sheave, a new reinforced steel sheave, is being introduced by the Texrope Division of the Allis-Chalmers Mfg. Co., Milwaukee, Wis.

The outside walls of sheaves sometimes bend under the strain of excessive overloads, with the result that they are thrown off true. The outside walls of the new Duro-Brace sheaves are reinforced by a convex steel plate, which strengthens these vulnerable areas to so great a degree as to practically eliminate the possibility of distortion, the makers state, irrespective of the strains to which they are subjected.



Duro-Brace Texsteel sheave

Welding at the rim and web, for additional strength, and the interior grid-type construction, for rigidity, which were advantageous features of the former design are retained in the new Duro-Brace Texsteel Sheave.

Industrial Literature

BULLETIN S-76, shows and describes the new Type EC dust filter, an improvement in many respects over the previous Sly dust filter design, particularly with reference to greatly simplified construction for easier access and reduced maintenance. Also, there is an increase in the amount of filter cloth, according to the W. W. Sly Manufacturing Co., Cleveland, Ohio.

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TRAYLOR Engineering & Mfg. Co., Allentown, Pa., has just published a new general catalog No. 5000, illustrating and describing their crushers, grizzleys and feeders, screens, scrubbers, elevators, mills, kilns and kiln feeders, coolers, dryers, and clay wash mills.

◆ Manufacturers' News ◆

DENTISTRY for Gear Teeth: There is perhaps no single damage that is of such frequent occurrence to machinery in general as the breakage of gear teeth. While the damage in itself may be small, it is often considered necessary to replace the entire gear in order to assure perfect coordination of the machinery. The properties of all-purpose bronze welding rod make it particularly suitable for such repairs, according to the Linde Air Products Company of New York City. This rod is said to be extremely wear-resistant, much more so that any of the ordinary materials used for gear castings. With proper care the welding can be done so efficiently that no machining is subsequently necessary.

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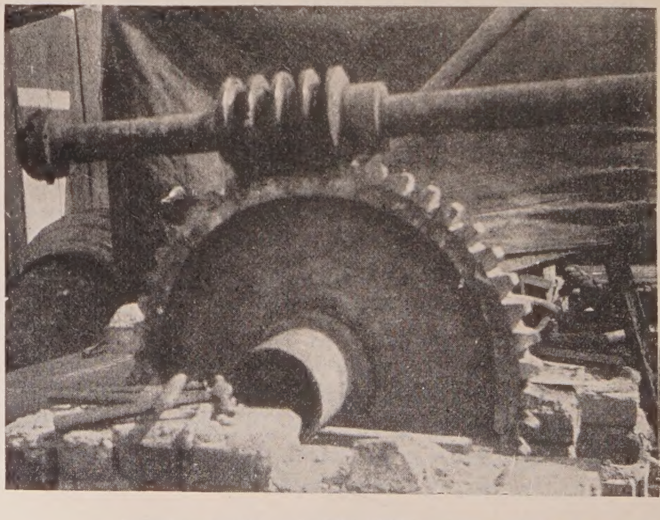
LINK-BELT Company, of Chicago, announces the purchase of the physical assets of the Bailey-Burruss Manufacturing Company, Atlanta, Georgia. All divisions of Link-Belt's Atlanta sales office are being moved to the Bailey-Burruss plant, which will henceforth be known as the Atlanta Plant of Link-Belt Company.



Gear 3 ft. in diameter with 45 large teeth about 1½ x 3 x 4. A number of the teeth on this gear were badly chipped and all of them showed great signs of wear. The rebuilding of all the teeth on this gear was done, the company says, for less than $50.00, with a total welding time of 16 hr.